PSYCHOLOGY
DOWN THE AGES

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BY

C. SPEARMAN

PH.D. (LEIPZIG), HON. LL.D. (WITTENBG.), F.R.S.

EMERITUS PROFESSOR OF PSYCHOLOGY IN THE UNIVERSITY OF LONDON. LATELY GROTE PROFESSOR OF PHILOSOPHY OF MIND IN THE UNIVERSITY OF LONDON. FOR. MEM. SOC. FRANÇ. PSYCHOL. HON. MEM. KENTUCKY ACAD. SCI., DEUTSCH. GES. PSYCHOL., BRIT. PSYCHOL. SOC., PSYCHOTECH. CLUB, PRAGUE

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PART D

WHAT FOLLOWS WHAT

CHAPTER XXVI

PSYCHOLOGICAL NEED OF LAWS

§ 1. The Call from James. § 2. Voice of Common Sense. § 3. Voice of Morality. § 4. Voice of Philosophical Die-hards. § 5. Long Initial Silence of Psychologists. § 6. Outburst in the Eighteenth Century. § 7. Subsequent Reaction. § 8. Situation Today.

§ 1. *The Call from James*

On the matter of laws, as on innumerable others, the outstanding literary expression comes from William James. At the close of the most successful book ever written on psychology, he characterizes this his own branch of knowledge, as follows:

> "A string of raw facts; a little gossip and wrangle about opinions; a little classification and generalization on the mere descriptive level; a strong prejudice that we *have* states of mind, and that our brain conditions them; but not a single law in the sense in which physics shows us laws, not a single proposition from which consequences can causally be deduced. We don't even know the terms between which the elementary laws would obtain if we had them. This is no science, it is only the hope of a science."

Now, the "terms" of the laws must somehow be derivable from the mental constitution which we have just been considering. Let us, then, look for the laws themselves.

§ 2. *Voice of Common Sense*

What is advanced by James as a lamentable fact from which we may hope sometime to escape has elsewhere

been regarded as an inevitable necessity. Such indeed would seem to be the view of common sense. The present writer was once conversing with a lady of exceptional ability and culture who asked him once more the old question, What is psychology about? I suggested that its mission was to ascertain the laws that govern the mind. She replied, "But I always thought that the mind did not obey any laws!" Hereupon interposed no less a person than the highest medical officer in the British Army. "You are perfectly right," he said to the lady; "laws do not apply to mind, but only to matter."

§ 3. *Voice of Morality*

Further, the claim to establish mental laws has often been repudiated, not only as futile, but even as degrading. It is thought to lower the status of man to that of a mere machine. An old lady with the best of intentions once demanded of the prospective mother-in-law of a colleague of the writer: "Is it true that you are letting your daughter marry such a wicked man as a psychologist?"

§ 4. *Voice of Philosophical Die-hards*

Discouraging, too, would appear to be the attitude of certain philosophers, by whom scientific psychology is regarded as an impertinent upstart; as one that would heap Pelion on Ossa in vain war against their own time-honoured reign. Such an attitude would seem to have had till recently its home, fortress, and citadel at Oxford. Thus Joseph, to the question whether there is any such thing as psychology, makes the following answer:

> "Certainly there is such a thing; but if I were asked what it really is, I should say, not a science, but a collection of more or less detached inquiries. . . . There are for example inquiries into 'double personality' and

kindred puzzles . . . there are experiments about association-time, reaction-time, etc. But psychology as a particular science about one sort of known things, viz. individual mind, parallel with sciences about other sorts of known things, which shall explain all the processes of individual minds . . . this is the psychology which I mistrust."

§ 5. *Long Initial Silence of Psychologists*

What, then, has been the general attitude taken up towards scientific laws by the psychologists themselves?

In the beginning, and for a very long period, these too seem to have given the matter little or no consideration. Take Aristotle, who anticipated modern thought so widely and so deeply, and whose bent was so preeminently scientific. His main work on psychology seems to leave laws entirely out of account. And such an abstention would seem to continue not only through the Middle Ages, but even into the Renaissance. In the work of Locke, for instance, laws would appear to find no mention whatever.

§ 6. *Outburst in the Eighteenth Century*

But a great change came over the scene about the middle of the eighteenth century. By such authors as Cumberland (Bishop of Peterborough), Wolff, Hartley, Reid, and even Tetens, laws were not only mentioned but pushed to a front place. Clearly enough, this movement was in emulation of the laws of physics which had just been propounded with extraordinary success by Newton.

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The movement persisted with all vigour throughout the nineteenth century. Some prominent names were Herbart, Stewart, Hamilton, Bain, Volkmann, and Wundt.

Still the situation was by no means unclouded. Hamilton, for instance, although he himself made great play with psychological laws, and even credited them to many earlier writers as far back as Aristotle, nevertheless upon occasion declared with all possible explicitness that in psychology laws do not really exist. It would appear that he, with many other psychologists, drew a fundamental distinction between, on the one hand mere laws, and on the other hand such as serve the aims of science.

§ 7. *Subsequent Reaction*

Anyway, there subsequently ensued a strong reaction. Towards the close of the nineteenth century, Heymans wrote that

> " The most recent trend of psychology is in the direction of *slighting* laws."

With still greater emphasis, Dilthey pours contempt on the whole endeavour " at explaining the constitution of the mental world by its constitution, forces, and laws ".

§ 8. *Situation Today*

At the present day, many psychologists continue the lines indicated by Hartley and others in the eighteenth century. This may be instanced by the work of Thorndike and his followers on the " law of effect ". That and kindred laws play no small part in the universally popular text-book of Woodworth. On a much vaster scale have been the eighty or more laws propounded by Yerkes. And J. S. Moore complains that even these are far too few !

Indeed many even of the psychologists most opposed to the thinking of Hartley have brought forth laws on

lines of their own. A notable instance is afforded by Spranger, disciple of Dilthey. Here may also be put the advocates of the theory of Gestalt. We must include the doctrine of "noegenesis". On the other hand, a great many psychologists—including some of the most eminent—seem to find the concept of law quite superfluous. If any two modern text-books stand out above all others for thoroughness, surely they are those of Ward and McDougall. Yet in neither do laws appear to find so much as mention.

In view of this curiously mixed and inconsistent situation, we are impelled to pause a little and consider the whole question of laws somewhat more fundamentally than is usual.

CHAPTER XXVII

NATURE OF SCIENTIFIC LAW

§ 1. Cardinal Requirements of Prevision and Retrovision. § 2. Assumption of Uniformity. § 3. Postulate of Analysis. § 4. Requirement of Definiteness. § 5. Requirements in respect of Scope. § 6. Requirement of Ultimacy. § 7. Requirement of Rationality. § 8. Ideality and Approximation. § 9. Upshot.

§ 1. *Cardinal Requirements of Prevision and Retrovision*

Such curious discrepancy of opinion as to the part played in psychology by laws may well warn us to approach the very idea of them circumspectly.

What *is* a " Law " ? And what sort of law can claim to be genuinely scientific ? How, if at all, does any sort carry us beyond the older psychology of " faculties ", as considered in Part B ? To matters of this kind must needs be devoted the present chapter. What lack there may be of immediate interest in these general considerations will, it is hoped, be made good on their subsequent application.

To begin with, we may confidently assert that what science seeks under the name of laws is, above all things, some large power of prediction. Never perhaps has this requirement been better expressed than by Hartley himself :

> " The proper method of philosophizing seems to be to discover and establish the general laws of action, affecting the subject under consideration, from certain select, well-defined, and well-attested phenomena, and then to explain and predict the other phenomena by these laws. This

> is the method of analysis and synthesis recommended and followed by Sir Isaac Newton."

An instance is supplied in physical science by Newton's three laws of motion, of which the first runs as follows:

> "Every body perseveres in its state of rest, or of uniform motion in a straight line, except in so far as it is compelled by forces to change that state."

As another instance may be taken Dalton's laws of chemical combination, of which the first is:

> "Elementary substances combine in proportions that are definite and invariable."

Long afterwards, this requirement of prevision appears in the quoted outcry of James. Scientific laws, he says, are those from which "consequences can be deduced".

And indeed the need of this service has become very urgent in psychology to carry out its great and growing employment in practice, whether this be education, medicine, industry, sociology, or anything else.

But we may suggest that the use of scientific laws includes the divination not only of the future, but also of the past. Thus in the case of physical movements, the laws may serve not only to predict the position of a body at any subsequent time, but equally well to disclose their position at any antecedent time. To such a backwards looking we owe, for example, our whole knowledge of the earlier conformation of the universe. The law-abiding sequence *a-b* is originally established by observation of what is occurring now. From this, our inferential knowledge passes, not only from other present *a's* to future *b's*, but also from other present *b's* to past *a's*. In psychology an instance of the need of such law-derived retrovision is furnished by all its genetic branches Take as example the description of what occurs in the

minds of very young children. Only too often such a description has little more claim to validity than a tale about the inhabitants of Mars. In place of such wild imaginative flights, the psychologist should if possible copy the procedure of the geologist. If once he can establish laws in places and times submitted to actual observation, he may then apply these laws even to regions that are remote and to eras both future and past.

But all this certainly does carry us far beyond mere "faculties". For the latter do not necessarily involve any occurrence at all; much less any occurrence that can be foreseen. To say that a person has the faculty or power of thinking states little if anything more than a bare possibility. It does not affirm that he ever will think or even has thought. It does not so much as hint at the conditions under which the faculty will be realized in act.

§ 2. *Assumption of Uniformity*

To these conditions let us now betake ourselves. One such is that, in common with all natural science, psychology assumes *that the general course of events is uniform.* But against this assumption stands in particular the alleged existence of free-will. According to many authors, any such freedom would preclude not only all science of mind, but even that of matter. But this appears to be an exaggeration. At worst, the perturbance introduced by any such "joker" could be handled in much the same way as are and must be treated the experimental errors.

But this condition of uniformity would appear to involve the further one of temporal *continuity.* The required uniform sequence of one event after another cannot hold, it has been urged, when there is any interval

between the two. If we know what a billiard ball is doing at any moment, we can infer what it will tend to do next. But we cannot infer what it will be doing after an interval long enough to permit the intervention of further forces.

This would appear to be a most disturbing limitation. For in point of fact, the course of consciousness does seem to lack continuity. Our knowings, feelings, and desires are for ever being switched off one thing on to another. And at times, as in sleep, conscious experiences appear to discontinue altogether. Here, then, is an obstacle to the establishment of laws which, even if it be not insuperable, at least needs watching.

Another corollary to the need of uniformity is that of *constancy*. Thus Sigwart protests that the mind suffers continual change by the formation of new dispositions, so that there is an absence of the fundamental condition for laws, which is the changelessness of the subject. But such an objection would seem to go too far. For it would preclude even any science of physiology, since this too deals with material that is for ever changing.

More serious perhaps is the consideration that in order to secure uniformity, the events at issue must needs be often *repeated*.

Take, for instance, Pascal's statement that "pressure exerted anywhere upon a mass of liquid is transmitted undiminished in all directions". This constitutes a scientific law because there are a great many masses of liquid and the statement applies uniformly to all of them. Let us suppose that, on the contrary, there was only one mass of liquid in the universe, and that at all other places and times matter was either in the solid or in the gaseous state. Thereupon, Pascal's statement would not be of a general law, but only of an isolated fact.

Now, how does psychology stand in this respect?

Are its situations really repeated or not? There indeed, a proverb that "history repeats itself". B is not this only in a superficial sort of way?

§ 3. *Postulate of Analysis*

Much more comfort would seem to be obtainal from the cited statement of Hartley. According this, the establishment of laws can be effected by t assistance of analysis and synthesis. For although t whole situation may never be repeated, its constituen as found in it by analysis do probably recur very ofte and therefore do in this respect satisfy the needs of law

But herewith we are back at the prevalent outc that when once a situation has been analysed into i constituents, these can never be put together into t original whole again. In general, this Humpty Dump doctrine has been discussed by us already in Chapter I One vital point, however, was reserved for treatme now. Suppose that somehow or other we have su ceeded in establishing laws for the constituents singl how are we ever going to use this information so to predict the result of them all simultaneously? Ma wild assertions or assumptions are current that any su prediction is impossible. But in truth, the problem very familiar to science. It is no other than that whi J. S. Mill called the Plurality of Causes and Intermixtu of Effects.

In the simplest case, *and this only*, the part-effec have merely to be added together. This is the so-call "mechanical" sort of composition. Mill writes of it follows:

> ". . . one cause never, properly speaking, defeats frustrates another; both have their full effect. If a bo is propelled in two directions by two forces, one tendi to drive it to the north and the other to the east, it is caus

> to move in a given time exactly as far in both directions as the two forces would separately have carried it."

With this he contrasts the other or "chemical" kind of composition:

> "Not a trace of the properties of hydrogen or of oxygen is observable in those of their compound, water. The taste of sugar of lead is not the sum of the tastes of its component elements, acetic acid and lead or its oxide; nor is the colour of blue vitriol a mixture of the colours of sulphuric acid and copper."

This "chemical" composition it is that he would introduce into psychology and there make fundamental. Upon this basis he imparts to sensism whatever plausibility it may possess. Unlike his father, he sees clearly enough that mental processes do not consist exclusively of sensations and feelings; but still he holds them to be *generated* by these. He does not assert that the properties of the compound are restricted to those of the elements; but he does suggest that the properties of the compound and those of its elements may possess

> ". . . some constant relation, which, if discoverable by a sufficient induction, would enable us to foresee the sort of compound which will result from a new combination before we have actually tried it." As examples are given Dalton's law of definite proportions, and the law of isomorphism (which indicates the identity of the crystalline forms of substances that possess in common certain peculiarities of chemical composition).

This, then, is really the doctrine of the atomistic associationists. It is not in the least like the "additive" procedure attributed to them by the Gestaltists. But it does seem unsatisfactory. To explain the properties of a compound by merely saying that they are somehow "generated" is not illuminating.

However, besides these two kinds of compound causation, the mechanical and the chemical, Mill supplies

us with a far more important third kind, designated
" conjoint ". He writes :

> " It is seldom, if ever, between a consequent and a sin antecedent that this invariable sequence subsists. It usually between a consequent and the sum of seve antecedents, the concurrence of all of them being requis to produce, that is, to be certain of being followed by, t consequent."

Suppose, for example, that a person dies of eating particular dish. The death might not occur in t case of other bodily constitutions, or of other states health, or even of other states of the atmosphere. V commonly omit mention of the many lasting conditio that contribute to an issue, and we speak only of son instantaneous event as being *the* cause.

Of such a nature would appear to be the gre majority of the causations commonly attributed " wholes ". Here belongs, for instance, the previous quoted case of the person who called a certain memb of his staff by her first name in his house, but by h family name in his office. Really, the cause was not t "whole" case, but only the concurrence of sever features in it. The case can be expressed mathematical by saying that the effect is a " function " of sever antecedent variables. Such a " function ", as everybo knows, includes an unlimited variety of interrelatior Of these the simplest is the so-called " mechanical or " summative ", or " additive " kind ; such an effe is sometimes entitled a " linear " function of the ant cedents. Here it is most important to note—in view much current reckless criticism of mere " sums "—th all science makes abundant use of this summative rel tion even when it is known to be untrue ; for it still ma furnish an extremely useful first approximation. Th fact is well stressed by Thurstone, who after citing son instances from physical science goes on to say :

"A parallel, in the description of human traits, is their description, in first approximation, as linear functions of a limited number of reference traits."

§ 4. *Requirement of Definiteness*

However, the preceding postulates, though necessary, are not sufficient. They are conditions that must be fulfilled in the nature of any events, in order that these should be brought under a law at all. But there are further conditions of a more specific kind.

Outstanding here is the need that it should be precise. It cannot possibly serve the aims of prevision and retrovision unless its terms are so well defined that these can be recognized. There is little use in knowing that A accompanies or precedes B, unless we can identify both an A and a B when we meet them.

§ 5. *Requirements in respect of Scope*

Let us pass on to some further requisites which, if less absolutely indispensable, are still vital enough.

One of these is that the law should have adequate scope. It must deal with both quality and quantity. It must hold for a large and important class of cases.

This need applies even more to *systems* of laws. In fact, the essential mission of science is to express *all* the uniformities of the universe in the fewest and therefore widest propositions.

§ 6. *Requirement of Ultimacy*

A further requirement is that the laws should, whenever it can be done, be reduced to others more general still; although indeed, for many purposes, laws which are not so fundamental retain much usefulness. Again,

rational laws wherever these seem to be useful, either as facts or as assumptions. But the empirical laws must always constitute the *irreducible scientific minimum*. All attempts to attain rationality must be dropped so soon as they appear to involve unprogressive controversy. In their place, we come down to brass tacks—the bare uniformities of sequence and of coexistence. The ultimate establishment of rationality shrinks to a mere hope. As was said long ago by De Biran :

> " *To observe the facts, classify them, establish the laws, seek the causes*, this is the order of procedure . . . for the spirit which tends to raise itself from the first stages of knowledge up to the highest degree which it is permitted to attain."

§ 8. *Ideality and Approximation*

We arrive finally at a consideration that is vital for some of the controversies of the present day. Asserted mental laws have been opposed on the ground that the observations do not satisfy them exactly, but require for this purpose some " rectification " or " purification ".

Such objectors seem to be unaware that even in physical science—and in the most successful regions of this too—such exactitude can never be actually attained.

In truth, all exact law is merely ideal. Actual experience can show nothing but approximations. Kepler only discovered that the radius vector of each planet *would* describe round the sun equal areas in equal times *if* there were no perturbing conditions. Even the so-called law of inertia has eventually been found to be inaccurate ; it loses its validity so soon as the velocity at issue approaches to that of light.

Lewes tells us :

> " The Ideal Law is of course inviolable because it is abstracted not only from all perturbations but from all

real processes. It expresses not *what is*, but what *would be* under other conditions. Motion is never uniform, never rectilinear; the stamen or pistil of a plant never is a leaf; the bones of the skull never are vertebrae; the planet never does describe an ellipse—these and all other Ideal Laws are abstract truths; and they can only be applied in explanation of concrete facts by a constant rectification of our natural tendency to mistake abstractions for realities."

So, too, nowadays Thurstone protests that:

"Each generalization in the scientific description of nature results in a loss in the extent to which the ideal constructs of science match the individual events of experience. This is illustrated by simple experiments with a pendulum in which the mass, the period, and the locus of the centre of gravity with reference to a fulcrum are involved in the ideal construct that leads to experimental verification. But the construct matches only incompletely the corresponding experimental situation. The construct says nothing about the rusty set screw and other extraneous detail.

"Since no mathematical analysis that can be conceived would cover all the subtle mysteries of personality, this realm is frequently judged to be outside the domain of rigorous science. But physical scientists accept rigorous scientific analyses about physical events that leave fully as much beyond the scientific constructs. Every explosion in the world has been different from every other explosion, and no physicist can write equations to cover all of the detail of any explosive event. It is certain that no two thunderstorms have been exactly alike, and yet the constructs of physics are applied in comprehending thunder and lightning without any demand that the detail of the landscape be covered by the same scientific constructs."

§ 9. *Upshot*

In the previous chapter we have encountered a wide discrepancy between the accounts given by different

psychologists of the role played in mental science by laws. To clarify matters, we have in the present chapter attempted to set forth the chief requirements and conditions of laws in order that these may fulfil the purposes of Science. To some extent, this is a continuation of the more general considerations in Chapter IV, especially the section on the legitimacy of hypothesis.

The main requirement now urged for the laws is that they should afford power of foreseeing the future, as also of divining the past. In order to secure this power, the most important conditions have shown themselves to be: in the first place, that the course of events should proceed uniformly and be amenable to analysis; in the second place, that the laws found to govern the events should have the greatest possible generality and ultimacy.

Further, the laws are much improved by being rational. But they may, if there is no escape, be merely empirical. Uniformity of sequence and coexistence is their *irreducible minimum.*

In any case, note must be taken that exact laws can never be more than ideal. Actual experience can hope for nothing but approximation.

Can psychology meet such requirements? Let us go on to see how it has attempted to do so.

CHAPTER XXVIII

ASSOCIATION OF IDEAS

§ 1. Law of Association. § 2. Two Utterances of Plato. § 3. Development by Aristotle. § 4. Culmination with Hartley. § 5. Back to Plato. § 6. Relation to " Ideas ". § 7. Further Points of Doctrine. § 8. Practical Applications. § 9. Distinction from Memory. § 10. Upshot.

§ 1. *Law of Association*

From all the preceding general consideration of the nature of scientific law, let us turn to the particular application which has been made of it to the study of the mind. Let us see upon what grounds it is that psychology—this Cinderella among the sciences—has made a bold bid for the level of triumphant physics itself. The law which above all others has been thought to work this wonder is that of " the association of ideas ".

Unfortunately, the term " association " has been employed in two fundamentally unlike meanings. The one is a matter of structure ; the other, of function. In the structural case, the word signifies how any different items in an experience stand to each other ; for instance, they might either be intimately fused together, or else sharply separated ; they might together constitute a mere sum, or else they might combine " chemically " and creatively. But in its other or functional meaning, an association between two items only means that the occurrence of the one tends to recall the other.

The structural case involves many difficult problems with which we need not trouble ourselves here. They

appertain to mental constitution and its analysis. They therefore belong to Part C of the first volume.

The second or functional meaning, on the other hand, is an extremely simple and straightforward matter of fact. The one item either does or does not tend to reinstate its fellow. This second meaning it is which forms the essence of the associative law, and consequently is the main topic of the present chapter.

Such a distinctness of the two meanings of "association" must not, however, be taken to imply that the two things are mutually independent. On the contrary, the way that two items are conjoined is likely to have a dominant influence on the subsequent power of the one to recall the other. Furthermore, those authors who incline to sensism will generally reveal this bias both in respect of the structural union and in that of the functional recall. Still such an entanglement of the two meanings does but oblige us the more to distinguish them.

To avoid ambiguity, then, it must be understood that here the "association" of different items is not going to signify how the two are structurally put together in consciousness, but only how one of them tends to recall the other.

§ 2. *Two Utterances of Plato*

In some fashion or other, the topic goes back to the very earliest writers, and forward to the latest.

Passing over the anticipation—as usual, extremely vague—attained even by common sense, we find already in the writings of Plato certain passages of profound significance. Thus he writes:

> "Lovers when they see a lyre, or a garment, or anything else which their darling is accustomed to use, are affected as follows: they both recognize the lyre and they appre-

> hend intellectually the idea of the person to whom the lyre belonged. . . . When we perceived something . . . there was no difficulty in receiving from this a conception of some other thing . . . which had been forgotten and which was associated with this."

But then Plato proceeds to set forth a second case of recall, seemingly on very different lines. He writes :

> "Does it not also happen, that on seeing a picture of Simmias, one is reminded of Simmias himself ? . . . Does it not happen, then, according to all these things, that recollection derives partly from similars ? "

Thus here, the power of one item to evoke another is no longer ascribed to any accidental "bringing near" or contiguity of the two in previous experience, but instead to an intrinsic similarity between them.

§ 3. *Development by Aristotle*

Turning from Plato to his great pupil, we find that in one of his works, according to many authorities, the doctrine attained to its highest development, its very zenith.

Most emphatic in this direction has been the enthusiasm of Hamilton. This author—in a way difficult to reconcile with his earlier refusal to credit psychology with any scientific law at all—rates the role of association in the sphere of the mind no less highly than the part played by gravitation in matters of physics. The effects, he declares, are no whit less multiform, extraordinary, and important in the former case than in the latter.

But, he adds :

> "Whilst the laws of Gravitation were only slowly developed by the labours of successive generations . . the not more obtrusive laws of Association, whose evolution modern philosophers fondly arrogated to themselves are, after these have tried and tired themselves in the attempt, found already developed and applied . . . at a single jet, by a single philosopher of antiquity."

hardly be called into question. It is that of Hartley, by whom the associative recall was first avowedly raised to the dignity of a law, such as those upon which Newton had founded physical science.

Hartley's exact formulation, however, is not very easy to find. For he gives his psychological findings primarily in the shape of formal "propositions", and of these he sets forth no less than a hundred and ninety-four. But eventually we seem to get what is wanted. In corollary No. 7 of Proposition No. XX, we are given at any rate a "theorem" that he says "comprises the whole doctrine of association". It runs as follows :

> "If any sensation A, idea B, or muscular motion C, be associated for a sufficient number of times with any other sensation D, idea E, or muscular motion F, it will, at last, excite *d*, the simple idea belonging to the sensation D, the very idea E, or the very muscular motion F."

To supplement this formulation we may quote his further statement as follows :

> "Sensations may be said to be associated together when their impressions are either made precisely at the same instant of time, or in the contiguous successive instants."

Comparing together the three outstanding pronouncements, that of Plato, that of Aristotle, and that of Hartley, we find them agreeing in the fundamental doctrine that one item of experience tends to recall another item when the two have previously been experienced either simultaneously or successively.

As to the nature of the items liable to such linkage, this naturally depends on the items into which the authors have respectively analysed mental constitution. Thus Aristotle broadly designates these items as "changes" or "processes" (κινήσεις). Whereas Hartley has to confine himself to the narrow sphere of "sensations", "ideas", and "muscular motions".

Another important difference is that Aristotle, as we saw, invoked *two* principles; besides that of temporal contiguity he brings in that of partial (or total) identity. Whereas Hartley lightly simplifies matters by dropping the second principle out of account.

But a far greater difference even than this is that, whereas all his predecessors had regarded associative recall as no more than supplementary in thought, Hartley takes it to be *universal*. Any further principle in thinking —such as the "natural tendencies" urged by Aristotle— he utterly repudiates. Thus the characteristic of his associative doctrine lies, not so much in what it includes, as rather in what it excludes. The occurrence of associative thinking had been known from time immemorial. But the claim that *all* thought is of this nature constitutes the "associationism" of which Hartley appears to have been the real founder.

Of subsequent associationists in the grand manner of Hartley there has been perhaps only one perfect example, namely, James Mill. He lays down that:

> "Our ideas spring up, or exist, in the order in which the sensations existed, of which they are the copies. This is the general law of the 'Association of Ideas.'"

And from this one law he proceeds to derive all conception, imagination, classification, abstraction, memory, belief, reasoning, and evidence, as also all emotions and all motives, together with "that peculiar state of consciousness which is called the Will". On the whole, a doctrine certainly rich in sweeping assertions, however poor it may be thought in cogent arguments.

Several other writers credited with the title of associationists appear not to deserve it, at any rate in our present sense of ascribing all or nearly all thought to associative recall. Thus even Herbart and his followers, besides giving to the recall their peculiar dynamic interpretations,

seem to find some additional room in their systems for such activities as those of judgment, understanding, and even reason. T. Brown, despite his claim to the contrary, seems to admit far more than mere association in his so-called "relative suggestion". Much the same may be said of Bain, when he claims to reduce all mental process to that of association, yet nevertheless declares the fundamental attributes of thought to be—in addition to "retentivity"—"consciousness of agreement" and "consciousness of difference". Spencer himself talks freely about knowing relations. Thus all alike—albeit sometimes under inappropriate names—have set up alongside of associative recall very different processes that would appear to fit better into the kind of thinking that Aristotle had originally designated as "natural" and "necessary".

§ 5. *Back to Plato*

For the rest, modern treatment of the topic of associative recall has mainly pivoted on the two cases set forth originally by Plato. But the literature has been kept fresh by its independence of tradition. Almost every point has been repeatedly forgotten and rediscovered.

A great many writers have striven to show that the case of similarity can at bottom be reduced to a special instance of contiguity. And in consequence of this believed reducibility, the case of resemblance has always found comparatively small notice in psychological literature. When "association" is mentioned, this almost always refers to the case of contiguity.

On the other hand, a few psychologists have done just the reverse. Prior for them has been, not the case of contiguity, but that of similarity.

Most numerous of all would appear to be those authorities who go right back to Plato again; since they admit *both* principles to be ultimate, that of similarity

(or partial identity) in addition to that of contiguity.

Outstanding in this direction have been Hamilton and Höffding. One of the two elementary cases is rigorously formulated by Höffding as follows :

> " Association of Ideas by Similarity.
>
> (Psychological formula : $a_1 + a_2$.)
>
> " The apple that is on the table in front of me (a_1) excites in my idea the picture of the fateful apple on the tree of knowledge (a_2)."

Under the same formula are said to come more remote similarities, analogies, parallels, metaphors, and allegories. Clearly, it is Plato's case of Simmias and his Picture over again. But Hamilton, leaning more on Aristotle, regards this similarity as being one of partial identity, and he brings the recall under what he calls the " law of repetition ".

The other elementary case is given by Höffding as follows :

> " Association of Ideas by External Connection.
>
> (Psychological formula : $a + b$.)
>
> " The idea of a man (a) leads naturally to the idea of his house, his friends, etc. (b)."

Hamilton brings this under the " law of redintegration ". Obviously, it is Plato's Lover and Lyre over again.

Höffding also gives the following case :

> " Association of Ideas by the Relation between the Whole and the Parts.
>
> (Psychological formula : $a_1 + (a_2 + b + c)$.)
>
> " When the idea of a fire (a_1) ' arouses the idea of a smithy, the connecting link is the smithy fire (a_2), but the images of the other objects in the smithy ($b + c$) emerge with it.' "

But this, as he himself concedes, is nothing more than the two preceding cases combined together.

§ 6. *Relation to " Ideas "*

In addition to this problem of the general nature of association, there have been many highly important but more specific questions about it. One is as to whether its scope is confined to " ideas ".

Now with Locke such a question hardly arose. For according to him, as is well known, the term " idea " included almost everything; not only the objects of thought, but those also of sensation. Subsequently, however, it became restricted to the former. And to ideas in this restricted sense alone it is, according to many psychologists, that the law of association applies. Writer after writer stresses the point that recall does not excite in the mind any sensations or other real experiences, but only thoughtlike ideas of these.

From time to time, however, there has been indecision on this matter; or even some degree of apostasy. With Gay, a century later, the associative excitement of the ideas of pleasure and pain is not very definitely distinguished from re-excitement of the pleasure and pain themselves. Moreover, even Hartley himself, as we have seen, included in the sphere of association not only ideas, but also movements.

The most curious case, however, is that of Bain. In his original enunciation of the associative law he stated that

> " Actions, sensations, and states of feeling . . are apt to be brought up *in idea*."
> (Italics are of present writer.)

But in 1901 his formal definition ran in almost exactly the same words as before, save that now even the actions, sensations, and states of feeling themselves are declared by him to be " apt to arise ". He explicitly adds that " the principle of association is *not* confined to ideas ".

(*Chambers's Encycl.*, Association of Ideas.) Thus, the whole associative doctrine as held throughout the ages, as formerly enounced by Bain himself, and even as indicated by him in the title of his later work ("The Association of Ideas"), is finally—without further comment—so greatly expanded as, seemingly, to be revolutionized. For it has come to include, not only the production of ideas of former experiences, but also the reinstatement of those experiences themselves.

Still this vastly larger scope, although so explicitly indicated by his theorem, is hardly borne out by his actual illustrations. These still touch little, if at all, the re-excitement either of "sensations" or of "states of feeling". Their extension beyond the region of ideas is almost wholly confined to that of the voluntary actions already allowed by Hartley. Bain only writes as follows:

> "A good example of the association of movements is furnished in our acquirement of spoken language."

And again:

> "The power of copying anything . . . is made up of associations between a visible appearance and the train of movements calculated to reproduce it."

§ 7. *Further Points of Doctrine*

Among kindred problems that have excited modern interest is the question as to whether the association by contiguity really did need for its explanation *both* the principle of simultaneous *and* that of successive previous experience. Some authors have thought that simultaneousness is sufficient to cover all cases. Others have, on the contrary, been satisfied with successiveness alone.

Another question, not independent of the preceding one, but of much greater practical importance, is as to

whether association by contiguity acts only forwards or also backwards. If in experience *a* is followed by *b*, will the sole result be that *a* becomes capable of recalling *b*, or will also *b* become able to recall *a*? When, for instance, a child only learns that *maison* means "house", will he subsequently on encountering the word "house" be able to translate this as "*maison*"? According to current psychology—derived from experiments with non-sense syllables—the recalling tendency does work in both directions, but much more strongly forwards. If this be so, then the learning that "*maison*" means house would confer some, but little, power of translating house by *maison*. However, subsequent experiments—which seem to have escaped the notice of most psychologists—cogently indicate that the learning of the syllables depends in varying degrees on *two different factors*: first, seeing the syllables; and then muttering them. The former factor shows itself to work just as well backwards as forwards. Whereas the factor of muttering (as of other movements) can only act forwards.

Among further more or less fundamental points treated by modern psychologists, one concerns the fact that the recalled idea very frequently is "tied" or "implicate"; that is to say, does not make its appearance as a distinct item, but rather as a "meaning" or "fringe" (see Chapter XV). Another important fact, stressed particularly by Steinthal, is that, although for convenience of exposition we generally take the simple case of a single idea reproducing another one, in reality there almost always are many items in play together.

§ 8. *Practical Applications*

Whilst modern psychologists dealing with the association of ideas have made such scanty contributions to its theoretical basis as established by Plato and Aristotle,

they can on the other hand be credited with very large progress in its practical applications.

Of immense importance here has been the assistance which can be derived from the theorem of Augustine, that the association between two items is generated through thinking them in relation to one another. This theorem, and its corollaries, fatally neglected by orthodox psychologists, has made the fortune of numerous un-academic writers on mnemonics.

In order to verify the virtue of this theorem, the reader may compare the ease of memorizing the following two lists of words (to be read downwards); in the case of list A attending to each idea on its own account, but in the case of B noting the successive interrelations.

A	B
sweet	dog
table	animal
summer	plant
pudding	rose
nature	smell
colour	taste
kingdom	food
foolscap	hunger
village	poverty
twenty	riches
fever	jewelry
chapter	ring
rifle	marriage
master	children

Whilst B can easily be mastered in a single repetition (backwards or forwards) A is more likely to need a dozen.

Not a little profit can be drawn from another discovery already mentioned; namely, that whereas pure motor association, as formed in muttering, works only forwards, the more intellectual association formed in vision works just as well backwards as forwards. Think of the universal prevalence of muttering in school work!

When is it serviceable, and when not? Quite a different line of practical usefulness must be credited to the "free" or "uncontrolled" association which was introduced by Galton. Here, a person allows his thoughts to wander about with the smallest possible constraint. In the commonest form of procedure, a single word is presented to him and he has to say what word occurs to him next. The results have chiefly been employed in two directions. A less fruitful one has consisted in submitting the associations to elaborate classifications, hoping thereby to illumine both the general laws of association and also the fundamental constitutions of the different individuals tested. The other and more successful endeavour has set out from the theoretical premise that a person's previous more or less casual experiences are the cause of his associations (by contiguity), and has hoped that, conversely, his associations would reveal something about his previous experiences. This hope would seem to have been justified. Such "uncontrolled" recalls do sometimes seem to possess the virtue, not only of disclosing important facts about a person's past history, but even of doing so when the person himself has completely forgotten these facts; indeed, even when he is doing all he can *not* to reveal them.

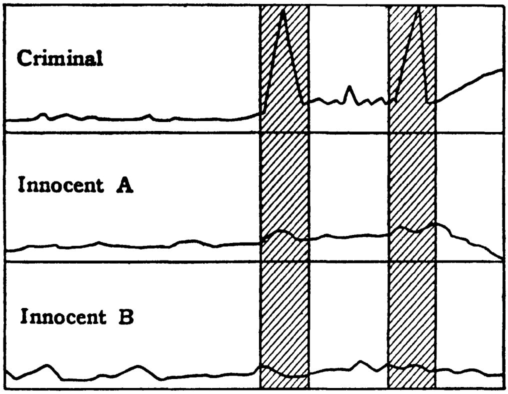
An outstanding instance of this usage of uncontrolled association has been in its application by Jung with Bleuler, Ricklin, and others to detect the hidden "complexes", especially sexual, which constitute the very foundation of the doctrine of psycho-analysis.

Among the many interesting minor uses of this diagnostic method may be mentioned that of Wertheimer to detect criminals. The following instance actually occurred to the present writer. Two jewels, a diamond brooch and a pearl ring, were suddenly missing, and presumably had been stolen. A newly engaged servant was suspected. Thereupon she was invited to play a

psychological "game" as we called it. Twenty-eight words were read out to her, and each time she was asked to say what other word first came to her mind. The ensuing reactions are given below. The five words calculated to excite abnormal responses in the guilty person and not in others are in italics. As will be seen, two out of the five betrayed the criminal by the extraordinarily long reaction-times—no less than fifteen seconds.

Stimulus Words	*Reaction*	*Seconds*
cap	person	4·2
muff	door	1·9
fish	stall	1·6
meat	window	2·1
cow	picture	1·2
note	plush (?)	1·9
sea	bedroom	2·6
grass	floor	2·2
theft	bird	2·2
box	hat	2·6
pen	scissors	1·4
pincushion	knife	2·1
brooch	book	4·6
diamond	basket	15·4
ruby	ornament	1·6
soap	pen	1·9
fire	table	1·6
boot	broom	1·6
room	paper	5·2
desk	door	2·6
prison	ruler	1·6
basin	bottle	1·9
ring	jug	3·0
pearl	brass	15·8
emerald	lamp	1·6
table	book	3·0
knife	basket	(watch did not start)
box	shovel	6·6

In the following figure the same results are expressed graphically, and those of two unquestionably innocent persons are added for comparison. In this figure the irregular line represents the series of reactions, from left to right. Its height above the base-line is proportional to the duration. The reactions for the five critical words are indicated by the shading.



In addition to this quantitative difference in the reactions, there were further indications of guilt in the quality of the responses. The suspected person was evidently trying to conceal the words that really occurred to her.

§ 9. *Distinction from Memory*

To many readers it may appear strange to find the topic of association treated with so little regard to that of remembrance. For most psychologists have taken the two to be very much the same thing. Aristotle himself almost wholly confined his exposition of association to making the soul "remember". Others, as Malebranche, followed suit.

But in point of fact, as we have just seen, just the most interesting cases of associative recall are those where remembrance—in the proper sense of the word—is

absent. Here, ideas are evoked in consciousness by virtue of associations formed in previous experience, and yet this experience itself is entirely forgotten.

Furthermore, this distinction between the two things, association and remembrance, is only in accordance with what we have already found in Chapter XVI. Indeed remembrance in its earliest and most essential stage (called in that chapter " primary integration ") does not seem to involve any association at all, even as subsidiary.

§ 10. *Upshot*

The most general impression from this chapter is that here at last scientific psychology has indeed made enormous advances upon anything within the compass of mere common sense. Had it achieved nothing further, it would already have become extremely interesting and useful.

But there may still be room for doubt as to whether after all it meets the requirements of a genuine scientific law.

By at least one high authority, Sigwart, any such claim has been rejected. The reason given is that the associative recalls are so extremely irregular as to baffle all attempt at prediction, and that they thus fail in the most indispensable scientific property.

But such a reproach would seem to be based on inadequate appreciation of what psychology has really achieved in this field. True enough, the nature of each *single recall* will usually be quite unforeseeable. Nevertheless, as we have seen, knowledge of the law of recall does confer both prevision and retrovision of various important *general* facts.

Possibly, however, the law may suffer from shortcomings in other directions. Whether this is so or not will become apparent as we proceed.

CHAPTER XXIX

LAW OF RETENTIVITY: DISPOSITIONS

§ 1. One Law resolved into Two. § 2. Material Analogies. § 3. Application to Memorizing. § 4. Application to Animal Behaviour. § 5. Development of Human Character. § 6. Assimilation (Regression). § 7. Contrast. § 8. Transfer of Training. § 9. Upshot.

§ 1. *One Law resolved into Two*

A vital comment to be made on the law of association—one, however, that does not necessarily impair its usefulness (see Chapter XXVII)—is that it must not be regarded as ultimate. That is to say, it can be resolved into others, which are more general and more fundamental.

Some indication this way may be derived from an analysis of the whole event. In reproduction by contiguity there are two experiences involved. In the first of these, any items A and B are somehow called to mind. In the second experience, A is again evoked; and thereupon B spontaneously follows. The most natural explanation for this spontaneous sequence seems to be that in the first experience some sort of tie has been established between A and B, and that in the second experience this tie is shown to be retained; now a "disposition" has been left. Let us turn to the reproduction by similarity. Here, on A being given in any manner, then without further ado there comes to mind something partly like A but partly unlike; let us call it (A + D). This time there would seem at first sight to be only *one* experience; namely, that of A-followed-by-

(A + D). But in truth another and earlier experience is tacitly assumed, namely, that of A^1, together with D. If such previous companionship of A^1 with D has *not* occurred, then A will *fail* to evoke (A^1 + D). And thus the whole event becomes quite analogous to the case of contiguity. In both cases, accordingly, we seem able to reduce the essence of reproduction from the complex "association" to the simple "retention" or "disposition".

This role played by retention becomes greatly accentuated when the two component experiences are separated by a long stretch of time. In that case, the event has three distinct stages; the forming of a tie between A and B, the retention of this tie (unconsciously?), and the eventual power of A to recall B.

These three stages obviously depend on different conditions, each demanding a law or principle of its own. And often the question becomes extremely important as to which of the three is at issue. When a person fails to recall a fact, had he never really been conscious of it? Or did the impression fail to be retained? Or, again, is there no present influence that can convert the impression into, shall we say, re-consciousness?

This need of analysis into different principles has been notably urged by Hamilton, who called the two later stages those of Retention and Reproduction, and claimed that, though the latter cannot occur without the former, still the two are essentially unlike. A similar view had before been vigorously enounced by Tetens.

Furthermore, the retention or conservation itself admits of division into two kinds. One consists in the fact that the original occurrence has a tendency to persist after the conditions that gave rise to it have ceased. In the other kind of retention, the original occurrence does lapse entirely; but it leaves behind a "disposition" or "trace" by which a recurrence is assisted. In both

cases the retention may either be of the items of experience, or else of the associations between these. In the words of F. C. Thomas, it may be either of "isolated" or of "paired" items.

The present chapter will be concerned with the kind of retention (of isolated or of paired items) which consists in forming "dispositions".

Certainly this retentiveness is nothing new. Even common sense seems to be well acquainted with it, however obscurely. And Aristotle appears to have had it mainly in view when he raised habits (ἕξεις) to supreme importance in mental life.

Provisionally, we may express this tendency as follows: *The occurrence of any mental process makes this easier to occur afterwards.*

But such a formula stands in need of being expanded or supplemented. What is meant by being "easier"? This indicates, in the first place, that a smaller stimulus will be effective. Thus it may happen that, when a tune is only heard for the second time, it may not be recognized until played throughout; whereas when it has been heard many times, it may be recognized from the very first bar. In the second place, a process may be said to become easier when it shows an increase in its rapidity, intensity, definiteness, or persistence (see Chapters XV, XVI, and XVII).

Another way in which the formula requires to be further developed is in respect of the chief conditions under which the facilitation produced by any occurrence attains to its highest degree. Commonly, these conditions have been declared to consist in the recency of the occurrence, its intensity, its frequency, and its emotional character. But this too is familiar enough even to common sense. When the old Jesuits said that repetition is the mother of studies, they did but give poignant expression to what had long been obscurely realized by

every schoolboy. A far more novel and important quantitative condition would appear to be involved in the above-mentioned theorem of Augustine (p. 33); that is to say, composite ideas are more easily revived when their constituents are interrelated.

Finally, we must already here urge a point that will be greatly developed later on. It is that the formation of dispositions is at any rate far from being any *complete* account of the event. On the contrary it can only be one aspect that has been separated from the others by way of abstraction and for the sake of convenience. As Line and Wees, also Bu, have told us, no amount of retaining can explain doing.

§ 2. *Material Analogies*

In addition to its virtue of appearing ultimate, this law of disposition or facilitation—far more effectively than any other mental character—has been illuminated by reference to physical matter, and moreover has on this basis been submitted to quantitative formulae.

Here we do not mean to quote the various attempts that have been made—notably by v. Kries, Semon, and McDougall—to explain mental retention by special hypotheses about the structure and function of the nervous system. For these special hypotheses, interesting as they undubitably are, cannot but partake of the obscurity in which all our present knowledge of the function of the central nervous system is still regrettably befogged. We refer rather to comparisons made with physical properties of greater generality and certainty.

Hobbes wrote (in his *Leviathan*, Pt. I):

> "All fancies are motions within us, relics of those made in the sense: and those motions that immediately succeeded one another in the sense; continue also together after sense; insomuch as the former coming again to

take place and be predominant, the latter followeth, by coherence of the matter moved, in such manner, as water upon a plane table is drawn which way any one part of it is guided by the finger."

A more celebrated instance has been afforded by Gassendi and Descartes, who likened the forming of mental dispositions to the folding of paper. Descartes wrote as follows :

> " The vestiges in the brain render it fit to move the soul in the same fashion as it was moved before, and thus to make it remember some thing, even as the folds which are in a piece of paper or a cloth make it more fit to be folded as it was before, than if it had never been so folded."

Malebranche followed suit :

> " Just as the branches of a tree which have long been bent in a certain way preserve some facility for being again bent in the same manner, so the fibres of the brain, having once received certain impressions from the course of the animal spirits and from the action of the objects, retain for a long time some facility for receiving the same disposition."

Several years later, Locke too declared habits to consist in

> " trains of motion in the animal spirits, which, once set agoing, continue in the steps they have been used to, which, by often treading, are worn into a smooth path, and the motion in it becomes easy, and as it were natural."

Typical of more modern writing on the subject is that of van Biervliet, who would explain what he calls " memory " by the fact that in general all solid bodies, and therefore in particular the nervous centres, are imperfectly elastic. That is to say, their particles, after being moved from one place to another, only return to an intermediate place.

More penetrating, however, has been the later treat-

ment of this subject by Schukarew, Brailsford Robertson, and Piéron, among others. With these authors the movements involved in cerebral activity are tentatively taken to be those of certain chemical reactions (" autocatalytic ") and therefore to follow a known formula. Subsequently, many other formulae have been developed, attaining in general to increasing scientific value. Notable workers in this domain have been Courtis, T. V. Moore, and (under the guidance of Reymert) Gulliksen. The last-named supplies a valuable summary of this whole movement.

§ 3. *Application to Memorizing*

One very large field for this law of facilitation is supplied by learning, especially in so far as this consists in memorizing. And to this domain in particular it is that the quantitative formulae have been applied.

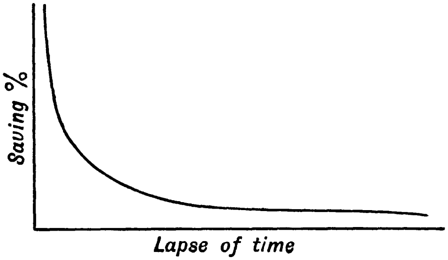
Thus Piéron reports that the formula of Robertson fits admirably the experimental results obtained by Ebbinghaus about memorizing. A similar application of the same formula to some experimental results of Smith made under the direction of Münsterberg, showed the following still more striking agreement between theoretical calculation and actual observation:

Number of Repetitions	Number of Syllables Correctly Retained	
	As Actually Observed	As Calculated from Formula
1	2·2	2·21
3	2·5	2·46
6	2·8	2·87
9	3·4	3·35
12	3·9	3·915

And if subsequent work, more reliable than that of Smith, has failed to manifest such extreme concordance, and

has even been obliged to change somewhat the formulation, still the agreement of the values observed with those calculated continues to be surprisingly good.

However, the preceding memory experiments have a grave disadvantage for our present purpose. They measure the whole actual recall, and thus mix up what we have found to be two distinct steps: disposition and realization. To measure the former apart, use may be made of the ingenious experimental method designated as that of "saving". Some mental material, such as nonsense syllables, is presented to the experimental subject often enough for him to be able to say or write it perfectly.



After a sufficient lapse of time, his remembrance will naturally be weakened. In order to recall the material without error, he will now need some further repetitions. These, however, will in general be less numerous than those which had been required originally. Such difference in number of repetitions is regarded as the "saving". The accompanying curve indicates the amount of this that, in one experiment of Ebbinghaus, was found to occur after intervals of varying duration. The shape of the curve appears to be what mathematicians call asymptotic. That is to say, with lapse of time the saving continually diminishes, but in such a fashion that it would *never* entirely disappear.

Here a momentous inference is suggested. The theorem has often been proposed, and as often rejected as fanciful, that no experience is ever quite forgotten. And obviously enough, there is no everlasting memory in the sense that under normal conditions all experiences can actually be recalled. On the contrary, most items

can no longer be recalled after so short an interval as a few minutes. Even the power to recognize them is known to disappear before very long. But on the other hand, the preceding experiment and others analogous to it do countenance the view that every mental action of a person leaves behind it a permanent disposition for such recall. Such a facility, however ineffective under normal conditions, may without extravagance be conceived as realizable when the conditions become abnormal. And certainly some marvellous restorations have been reported in cases of fever; even of hypnosis.

As another outstanding example of scientific achievement about the facilitation of learning, we may quote the difference established by G. E. Müller between its immediate effectiveness and its subsequent durability. The syllables to be learnt were divided by him into two equivalent portions. One of these was presented to the subjects 6 times and tested after the lapse of one minute; the result was that, on an average, 2·1 syllables could be recalled without further ado, but that 17·8 more repetitions were needed for the recall to be complete. The other portion of the syllables was presented 20 times, but was not tested till four hours later; this time only 0·2 syllable could be recalled at once, which was far worse than before; but, on the other hand, only 13·6 more repetitions were required to regain complete mastery, which was much better than before. Such a result seems not unimportant both for teachers and for pupils. For instance, it is clear that the ordinary examinations in schools and universities can only test dispositions in respect of present effectiveness. They leave out of account their far more important character of durability.

A great many further facts concerning memorization, which before had only been more or less vaguely suspected, have in modern times been established definitely and even quantitatively. In most cases, our law of

disposition or facilitation will still be found to exert an important influence, though not, it is believed, the sole one.

Among such facts ascertained about memorizing may be cited the advantage to be gained by suitably arranged "recitation". Here, when the learner has read his lesson a few times, he does not continue to read it until he knows it perfectly; instead he attempts to recite it forthwith, prompting himself whenever he fails.

Another instance of a problem of dispositions successfully attacked by way of experiment has been the ascertainment of the advantages of what has been called the "spacing" of the repetitions. By this is meant the interposition of intervals between the successive repetitions.

Instructive, too, has been the investigation of the respective advantages and disadvantages of dividing up the material to be learnt as compared with treating it as a whole. In the former method, the material is divided into parts, and each part is learnt separately. In the latter method—which is usually, but not always, somewhat superior—the entire material is repeated from end to end until it is all known.

Many further instances could be cited, such as those comparing the conditions of recall with those of recognition, or those trying to determine the influence of mental images.

Altogether, we find quite an impressive array of scientific results which largely derive from applying the law of dispositions to the sphere of memorizing.

§ 4. *Application to Animal Behaviour*

But let us go on to another and very different sphere of facilitation. Towards the end of the nineteenth century all biological science, including psychology, had

been invaded and become dominated by one great theme: that of the adjustments which each organism makes to its environment. To study these adjustments the modern biological school seized upon the fact of associative dispositions. The actions or other mental events facilitated are now called "reactions" or "responses". The associations themselves are termed "connections" or "bonds".

Along these lines, the lead was taken by the very influential work of Thorndike in 1898 on Animal Intelligence. Later on he writes:

> "Any fact of intellect, character, or skill means a tendency to respond in a certain way to a certain situation —involves a *situation* or state of affairs in the man, and a *connection* or bond whereby the latter is the result of the former."

In part, he says, these bonds are traceable to man's "original nature". The aim of education is to modify these. Some are to be perpetuated by giving them exercise and associating them with feelings of satisfaction. Others, conversely, are to be eliminated by denying them exercise, or by associating them with dissatisfaction.

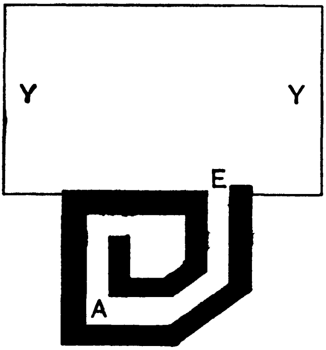
His list of original tendencies has already been given (Chapter X). Their subsequent modification is brought by him under three laws: those of Readiness, Exercise, and Effect. The first will be reserved for consideration later. As regards the other two, we may note that the very word exercise had been commonly used by the ancient psychologists with reference to the faculty of conservation or facilitation. In principle, Thorndike's law was their law. But he far outstripped them in that he brought its manifestations within the scope of experimental research; for the most part, however, applied only to animals.

As an example he gives the case of several chicks,

6 to 12 days old, kept in a yard (YY) adjoining which is a pen or maze (A-E). See figure below.

> " A chick is taken from the group and put alone at A. It is confronted by a situation which is, in essence, *Confining walls and the absence of the other chicks, food, and familiar surroundings*. . . . When it jumps at the walls, it has the discomforts of thwarted effort . . . when it runs to E, it gets out and has the satisfaction of being with the other chicks, of eating, and of being in its usual habitat. . . . It has formed an association, or connection, or bond, between the situation due to its removal to A and the response of going to E."

For the outstanding example of analogous work published later than that of Thorndike, we may turn to Pavlov. Here once more there is a rejuvenation of names. The same behaviour that had previously been called the " reaction " is now designated as a " reflex ". And in this wise the materialists, having long failed to enforce their view on common sense by dint of emphatic assertion, now more subtly employ words that quietly assume it. Another linguistic refreshment is that the linkages acquired by simultaneous or immediately successive experiences are no longer designated as " associated ", but as " conditioned ". Conversely, the linkages formerly called " innate " or " original " are now said to be " *un*conditioned ". Again, whereas Thorndike talked of the reactions being " eliminated ", Pavlov uses the more picturesque word " extinguished ". Yet again, whereas Thorndike's animals learn by " analysing ", Pavlov's do so by means of their " nervous analysers ". As a further characteristic of Pavlov's researches, the



reactions or "reflexes" investigated by him have consisted almost exclusively in the tendency of the mouth to water at the sight of food.

As for their actual work, the following instance is elementary, but otherwise typical enough. Originally, as one might expect, a dog was found by him to secrete saliva on being presented with food, but not on being made to hear a metronome. But next the animal is on several occasions stimulated by the sound and then immediately presented with food. Eventually, mere sound without food was enough to bring about the salivation ; this act is said now to have become "conditioned". More advanced experimentation consisted in diversely refining and combining the stimuli, as also in subsequently submitting the animal to various medical and surgical interferences, all this being done most acutely, extensively, and indefatigably.

What has been the harvest ? Beyond doubt, this Pavlov school has made a very remarkable contribution to animal physiology and even to psychology. In particular, it has produced a very large crop of observations that cannot fail to have permanent scientific value. But less favourable would appear to be their achievement in the way of interpretation. For this seems to have already been gravely shaken by the far more penetrating methods and investigations of Lashley, who greatly extended, diversified, and refined all the chief experimental features; especially the training, the testing, and the surgical operations (see Chapter II).

§ 5. *Development of Human Character*

Less novel and less exact, but nevertheless far more important, than all this application of the facilitative principle to the behaviour of animals has been its use towards explaining the development of human character.

Here comes the formation of habits which, as already mentioned, is well appreciated by common sense. Every-one knows the old saw of Ovid that " nothing is stronger than custom ", as also the saying of Plutarch and countless others afterwards, that custom is " second nature ", which Wellington capped by saying : " It is *twenty times* nature ! " So, too, Hamlet, " Use almost can change the stamp of nature ".

Not unfamiliar to most people is also the view that the effect of associative linkage can produce more than automatic habit ; it can influence the will. The stock example is the case of the miser. He is supposed to save money first in order to spend it on some anticipated later situation. But in time the pleasure which originally belonged to the anticipated situation becomes firmly associated with the bare act of saving.

Another familiar instance of association affecting character is afforded by the strong emotions that become attached to what were originally mere symbols : a flag ; a flower ; a lock of hair.

Akin seem to be some cases of the psycho-analytic so-called " mechanism of conversion ". We are told of a girl who happened to have her arm stretched upward at the moment when she heard that her lover was unfaithful. From that date she is said to have suffered from pains in her shoulder.

In the preceding case one single experience is reported to have generated a permanent tendency : the lack of repetitions of the experience was compensated by the intensity of its emotional character. And indeed, such an influence of emotion seems common enough. It is well known in religious conversion. Politicians are constantly turning it to their purposes.

But as regards nearly all this developing of character by the forming of dispositions, our knowledge seems to have been derived throughout from common experi-

ence. Scientific psychology has contributed almost nothing. Far from leading, it appears to have lagged behind. The problems in which it could not help, it has treated as non-existent. The very words "will", "motive", "purpose", and so forth, which embody the most urgent of all mental difficulties, are by many psychologists more or less ignored (see Chapter XVII).

Fortunately, however, even within this field of character scientific experiment is beginning to make some contributions. In a research of Boyd Barrett, for example, his subjects had to choose repeatedly between various pairs of originally unfamiliar drinks offered to them; each time they had to give a careful account of their actual experiences. The most striking result was what the author called the establishment of "motivation tracks". When all went well, not only did the reaction-time become continually shorter, but the action tended to occur involuntarily. Thus, one subject was offered two drinks, D and E, the latter being known from previous experiments to be much the pleasanter. The subject reported as follows:

> "Read simply D and E. Then a very short moment of blankness—then took impulsively E and drank. Can't discover anything else than the perception of D and E. They are directly symbolic. *No motives; all was impulsive.*"

Again, if the subject too often allowed himself to hesitate in choosing, then this hesitation became a habit, and an unfavourable one:

> "... *the mind seemed to hang in anxious suspense* between the two decisions. Hesitations were usually accompanied by painful or depressing feelings; such feelings of discouragement, disappointment, regret, and annoyance, effacement, lassitude, disgust, and even anger."

A still more vital problem, whose investigation has at least begun, concerns the part which dispositions play

in the respective effects of reward and punishment. In order to bring anyone to adopt or discard some course of action, he may be either rewarded when compliant, or punished when non-compliant, or both. The choice between these three educative methods would seem to be much assisted by consideration of the associations formed by them respectively. Outstanding among the recent experimental studies in this field of reward and punishment has been the work of Thorndike.

§ 6. *Assimilation* (*Regression*)

Another application of our law is more subtle, but also more universal.

According to its formulation, the occurrence of a process facilitates the *same* process subsequently. What effect will it have, then, upon a subsequent process which is not the same, but only more or less *similar* ?

Suppose, for instance, that anyone familiar with plums sees for the first time a mango. One natural result would be that the mango, by virtue of its similarity, recalled the idea of the plums ; so far we are only back again at Plato's case of the portrait recalling to mind the person portrayed.

But another possible issue consists in the mango being *mistaken* for a plum. Here the characteristics of a plum are not only recalled ; they also are projected upon and fused with those of the mango. Otherwise expressed, the present percept of a mango acquires more or less likeness to the previous percepts of plums.

Now, the influence of such assimilation or regression would appear to dominate the whole course of thought, and even of perception. Every idea formed by anyone in any situation tends to regress towards the allied ideas entertained by him previously.

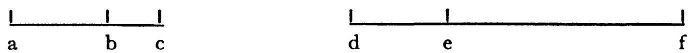
Most obvious and potent, perhaps, is this influence

in respect of words. In every speech or writing each word is ostensibly chosen to fit as best it may some particular present thought. But involuntarily the word chosen brings along its old associates. It revives characters and suggestions that may have suited many previous occasions well enough, but yet fail really to harmonize with the present occasion. Indeed such insidious adulterations of the truth appear to constitute a large part of most argument and oratory.

Important, however, as is this fact of assimilation in mental life, it seems to have attracted little notice from, and achieved still less success with, scientific psychology. But a notable exception has been the admirable work of Thouless on " Phenomenal Regression ".

§ 7. *Contrast*

Under this heading of " dispositions " can even be brought not only assimilation but some cases seemingly of its opposite, contrast. Take the following example:



Sometimes the length a–b seems longer than d–e, owing to the fact that a–b gains by contrast with b–c, whereas d–e loses by contrast with e–f. Here one can suppose that the impression of length in a–b obtained when comparing it with b–c leaves some disposition to this impression even when contemplating it by itself; reversely, as regards d–e and e–f.

§ 8. *Transfer of Training*

We will conclude by considering a further case where the earlier and the later experiences of a person are not

the same but only more or less similar. It is the case where the original experience at issue consists in some training for an ability or virtue, whilst in the subsequent experience the effect of the training is put on trial. At stake here is nothing less than the whole art and science of education. Unfortunately, just on this supreme matter there has been—to some extent, still is—a most violent clash of two opposing doctrines.

The one view, commonly known as that of "formal training", has been perhaps most simply and lucidly expressed as follows:

> "Every normal act of the mind leaves as a result an increased power to act in like manner . . . the power and tendency of the mind to observe is increased by observing; to imagine, by imagining; to judge, by judging; to reason, by reasoning, etc."

As representative of the opposite view, or anti-formalism, we may quote the following passage by Thorndike:

> "The mind is by no means a collection of a few general faculties, observation, attention, memory, reasoning and the like, but is the sum total of countless particular capacities . . . each of which must to some extent be educated by itself."

The plain man would appear to have always inclined strongly—though, as usual, not very consistently—towards the side of formalism. For him, a person does learn to observe by observing; to reason by reasoning, and so forth. From the earliest times, common educational practice has followed suit. With the old Greeks and Romans, for example, gymnastics, music, and oratory seem to have been regarded as a general training, effective for all particular species of civic need. On the advent of the Renaissance with its novel custom of writing books in the vernacular instead of in Latin, the

latter language was still universally taught in schools, the ground alleged being that from its study the whole mind

> "took fibre, facility, strength, adaptability, certainty of touch."

Subsequently, analogous though milder claims were made for other subjects of instruction. To arithmetic was assigned the function of training general judgment. Botany did as much for general observation; manual exercises, for general dexterity; rhythmic gymnastics, for the general "habit of thinking quickly and definitely".

As for the attitude of scientific psychology, this we saw to have been originally, and for long afterwards, preoccupied with mental "faculties". And these, if they did not explicitly support the formalistic view, were at any rate easily turned in its direction. If a faculty exists, why should it not admit of being cultivated?

Conversely, when these faculties came to be fiercely attacked—notably by Locke and Malebranche—then the doctrine of formal training was evidently in danger. But the main assault arrived with Herbart, who was never tired of pouring upon it invective and ridicule. And his mantle fell in recent times upon John Adams.

So much for mere assertion and counter-assertion. The decisive stage in the approach to the problem was not reached by psychology until this undertook to treat it by way of experiment. Such studies have especially included sensory and perceptual discrimination, motor adjustment, memorizing, and various school activities. Owing probably to difficulties of technique, there has been little study of the higher functions. However, one research, that of Shendakur, did elaborately investigate the effect of training in arithmetic. He applied many different methods of such training for prolonged periods of time. Then he proceeded to ascertain the various consequences that the training produced upon further

performances (arithmetical and otherwise), which had varying degrees of likeness to it. In general, the influence was found to be surprisingly small.

Along very different lines has been the work of Laycock, who depicted to his subjects a critical situation, and then trained them to meet other situations more and more closely resembling it. For example, one such critical situation given by him was that of a man in charge of a bank being held up by another man much smaller than himself but armed with a gun. The sole feasible plan was to divert the burglar's attention and then pounce on his gun. The first of the training situations only resembled the critical one in the general fact of requiring a diversion of attention; a panic arising at a concert from an alarm of fire was checked by the leading lady stepping on the platform and commencing a beautiful song. In the last of the trainings, the diversion became much more like the kind actually needed: Harold wanted a piece of chocolate held by George, so he said to him, "Look at that big dog outside". As George turned his head, Harold snatched away his chocolate.

As regards the conclusions derived from all this investigation, the earliest work was affirmative. Training in memorizing one thing did appear greatly to improve the power of memorizing other things. But this result was soon shown to come solely from inadequate experimental technique. Later research indicated instead that such large transfer never really occurred, though a small transfer was fairly common.

Interest soon turned to the conditions on which the transfer depends. Thorndike and Woodworth attributed it to the presence of identical elements, thus harking back to Aristotle (see above in this chapter). Originally these were taken to be elements of content. Later, more importance was attached by Judd to common elements of procedure. His work was illuminative of the influence

of generalization and abstraction. Further, he showed that transfer did not always bring improvement. It might easily consist in transferring a procedure from a situation which it fitted to another which it did not.

On the whole, the most modern work seems to support the ancient dictum of Agesilaus, who, when asked what boys should learn, replied: "That which they shall use when men". No less definite was the later teaching of Epictetus:

> "Every habit and faculty is preserved and increased by corresponding actions; as the habit of walking, by walking; of running, by running."

§ 9. *Upshot*

Altogether, the progress of psychology attributable to this "Law of Dispositions" is very remarkable. The law seems to have been realized clearly by several psychologists, and dimly by everyone, including the plain man.

In several highly important domains, such as development of character and tendency to regression, psychologists have turned the law to little advantage; less, in fact, than that already achieved by common sense.

But in other momentous fields, such as that of memorizing, and above all that of transfer of training, psychology has already pushed far ahead and seems likely to become one of the revolutionary forces of society.

On the more formal side of the law, too, we seem entitled to claim that the requirements of science, as laid down in Chapter XXVII, have on the whole been very successfully fulfilled.

CHAPTER XXX

LAW OF RETENTIVITY: INERTIA

§ 1. Gradual Stopping. § 2. Gradual Starting. § 3. Unconscious Persistence. § 4. Persistence involved in Memory. § 5. Assimilation. § 6. Resistance to Change. § 7. Need for Separate Law. § 8. Upshot.

§ 1. *Gradual Stopping*

In Chapter XXVIII we did not lead off from any essential point of view, but only from historical opportunity. As in the case of analysis (Chapter IV) we considered that the truth is always the truth, no matter where we may happen first to bite into it. We chose the case where the reign of a law, comparable with those of physical science, had been most commonly (though not universally) accepted; that is the law of "association". But association, we found, could be and had been resolved into two stages: retention and reproduction. Moreover, the retention itself is divisible into two manifestations: the one, an ensuing persistence of the excitement; the other, a subsequent disposition to re-excitement.

Then in Chapter XXIX we proceeded to consider this subsequent tendency to form dispositions. And here again the facts—in part, extremely familiar—appeared to admit of formulation not only as a scientific law, but even as one more fundamental than in the case of association.

In the present chapter we will turn to the other case—

that of persisting excitement (and allied events). Do here also the facts—for the most part, far less generally known—admit of expression in any genuine law?

Once again we find already with Aristotle a line of thought that has anticipated a great deal of modern work:

> "Those feel the vexation most who happen to have fluid in the region of the sensory organ, for once the fluid substance is set in motion it is not easily brought to rest until the object sought for returns to mind and the process resumes its direct course. Hence, when they have set something in agitation, emotions of anger and fear, owing to the reaction of these organs, do not come to rest; on the contrary they react once more on them. The phenomenon resembles that which occurs when a name or a tune or a sentence has come to be much on one's lips; after one has stopped, and without one intending it, one is prompted again to sing or to speak."

Note the striking simile—or was it meant to be more? —of a fluid substance set in motion and not easily brought to rest! Also the daring generalization, so as to take in such cases as the automatic recurrence of a tune or sentence!

Analogous and, though less dramatic, more amenable to exact study is the well-known frequent persistence of sensations for some time after the stimulus which gave rise to them has ceased to act.

As early a writer as Malebranche was struck by this phenomenon in the case of vision. By the time of Hartley, at any rate, it was generally known:

> "*The Sensations remain in the Mind for a short Time after the sensible Objects are removed.* This is very evident in the sensations impressed on the eye. Thus, to use Sir Isaac Newton's words, 'If a burning coal be nimbly moved round in a circle, with gyrations continually repeated, the whole circle will appear like fire; the reason of which is, that the sensation of the coal, in the several

places of that circle, *remains impressed on the sensorium*, until the coal return again to the same place.' 'Thus also, when a person has had a candle, a window, or any other lucid and well-defined object, before his eyes, for a considerable time, he may perceive a very clear and precise image thereof to be left in the *sensorium*, fancy or mind (for these I consider as equivalent expressions in our entrance upon these disquisitions), for some time after he has closed his eyes.' "

§ 2. *Gradual Starting*

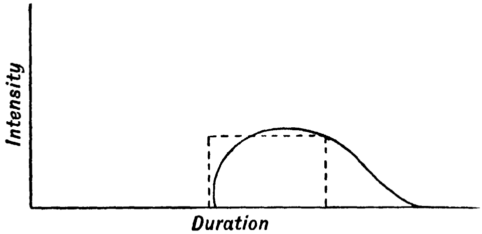
Subsequently, the observation was added that mental processes take appreciable time, not only to stop, but even to start. Thus Marcus Herz in 1791 noted that every presentation required a certain duration in order to become clear. A succession of presentations can only become effective, he said, if each is allowed sufficient time. Not long afterwards came Herbart, with whom the duration of the rise of sensation to consciousness was expressed in his most fundamental quantitative formula.

An elementary modern experiment consists in rotating a disc with alternate sectors of black and white. If the rotation is very slow, the sectors will present sharp margins. But on the speed being increased, the rear margin of each white sector will become blurred, showing that the sensation produced by the white light falling on any place in the retina does not cease immediately the light moves away, but instead persists a little while. This fact would seem to indicate that the subsidence of the visual excitation is retarded by some sort of inertia. Furthermore, though to a less degree, the front margin will also become blurred, showing that the beginning of the sensation, like its end, is not instantaneous but gradual. Quantitatively the whole mental result of displaying a white light for about a second is illustrated

by the following figure, where the dotted straight lines refer to the light stimulus and the curve to the white sensation.

One of the finest researches on this phenomenon has been contributed by McDougall.

The present writer had occasion during the War to investigate its bearings on the most favourable rate of



rotating searchlights. Here is an extract from the ensuing report:

> "The fundamental result obtained is extremely simple and easy to remember. Provided always that full attention be given, then forms elementary enough to be perceived in a single mental operation—such as the general shape of an uncamouflaged ship, buoy, submarine turret, or periscope, or a body of troops—need only be seen for one second.
>
> "This limit of time remains constant whatever may be the distance, minuteness, darkness, or colour of the object, whatever the darkness or colour of the background, and whatever the mistiness of the atmosphere. When any of these conditions are unfavourable, there will, of course, be a corresponding loss of vision. But this loss cannot in any degree be made good by looking for a longer time.
>
> "The above law continues to be valid when the searchlight is rotated. Consequently, if the diameter of the beam is 3 degrees, the maximum visibility will be retained up to 3 degrees per second. If the diameter is only 2 degrees, the rate must be proportionately decreased."

Still more marked is the lag in the case of adapting

oneself from a bright light to a dark one, or vice versa. Here the change may take a minute or more.

As for the rest of the senses, a long after-effect has been observed in the cases of pressure and of temperature, but a very short one in that of sound. The cases of taste and smell can hardly be investigated, since there is no known satisfactory means of instantaneously cutting out the stimulus. This lingers on the palate or in the nose.

Analogous in many ways is the course of a reflex, such, for instance, as the scratch of a dog (" spinal ") when lightly touched on his back. The action takes about 0·14 second to start; this delay is called the " latency ". For it to stop may take 100 times as long; this is the " after-discharge ".

§ 3. *Unconscious Persistence*

However, to appreciate the full momentousness of such persistence, we must betake ourselves to those cases where, seemingly, it occurs without our being aware of it.

The following is a well-known instance elicited incidentally by experiments which really had other aims. After the subjects had been told what task they had to perform and were waiting for the signal to begin, they noticed that commonly the idea of this task completely faded out of consciousness, but proved to remain none the less effective as soon as the signal was given. They were, so to speak, unconsciously " set " for the task. And this observation may be verified throughout all ordinary experience. Every one of us is continually resolving to do something in the near future. For example, to go home after paying a visit. Soon the idea of going home gives way to many others, but still when the appointed time arrives it usually does its work. Another familiar instance is when a person sets himself

to talk to someone in a foreign language. The set holds good without his having to go on thinking of it. An allied case is what has been called the effect of the "constellation". This means that a person's thoughts and feelings are greatly influenced by all his experiences during the previous few moments.

Such unconscious persistence may be carried to surprising lengths in what is known as post-hypnotic suggestion. Lloyd Tuckey reports that having hypnotized a lady he told her that on waking she would not see her husband (though the latter was sitting only a few feet from her). And so it happened. Although seemingly wide awake, she made no response whatever to her husband when he spoke to her by name; requested her to stir the fire, asked what there was for supper, and put a number of other questions. But all the time she had no suspicion of having been forbidden to perceive him.

But here a warning seems needed that possibly, and even probably, the persistence of resolves derives from more than one source. In the present chapter we have in mind the kind of persistence that comes from mental inertia; not that which expresses volitional vigour. So different are the two that the former is increased by fatigue, whereas the latter is decreased.

§ 4. *Persistence involved in Memory*

Connected perhaps with the phenomenon of mental persistence—but less certainly and unequivocally so—are certain facts about memory.

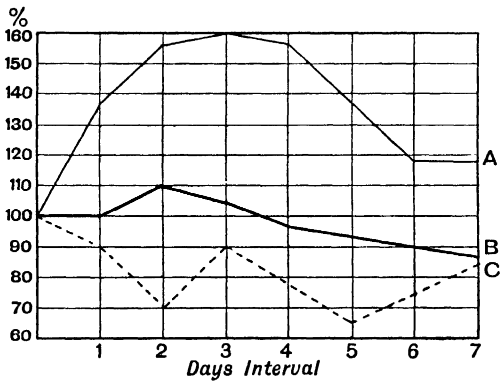
To begin with, there is the kind designated as "immediate", which means that it issues out of the actual experience without any gap of forgetfulness (see description of Memory in Chapter XVI).

Here may also be counted the familiar case when an experience, although at first it does apparently drop out

of consciousness, yet soon afterwards spontaneously reappears. Familiar instances are catchy tunes, problems of chess, objects perceived in a microscope.

Possibly we may even include the phase of memory known as consolidation. Remembrance of a lesson is found to be improved by allowing a little time for it to settle down before turning to any other absorbing activity. Conversely, a violent shock, bodily or even mental, may produce oblivion of the experiences immediately preceding it.

In some way related to this consolidation would appear to be the amazing experimental results obtained by Ballard and named by him "reminiscence". He found that when his subjects memorized various materials on one occasion and were tested for their remembrance later on, their power of reproduction did *not* always deteriorate with lapse of time; on the contrary, it could even for some days show marked improvement, as indicated in the following diagram:

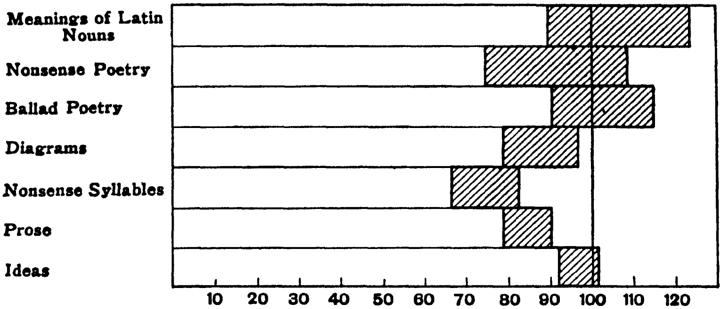


Memory Curves for subjects of different ages—A about 6 years old. B about 12. C about 21.

The curves show the amount retained after the intervals as percentages of the amounts retained without any interval.

In the rectangles the unshaded part of each shows how

much of what was known on testing without any interval continued to be known a day later. The shaded part



shows how much of what was *not* known without the interval was nevertheless known after the day's interval.

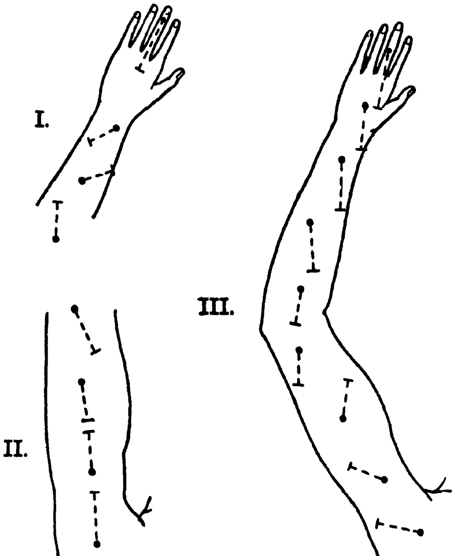
§ 5. *Assimilation*

For another field of mental persistence we may turn to assimilation again, or the phenomenon wherein a later experience "regresses" towards earlier ones allied to it (see previous chapter). Such regression would appear to be greatly accentuated when the previous experiences are very recent; it may be taken to indicate that these are still in some sort persisting.

The following is an experimental instance. The subject was made to tap for some minutes keeping in time with a metronome. Then he was instructed to tap a few more seconds with the metronome, but this now going at a different rate. Finally he was told to continue this second rate without the use of the metronome at all. In general, he soon lapsed back to a rate intermediate between the second and the first.

Another example may be supplied by the following experiments made by the present writer (and mentioned in Chapter XIII, p. 218). The subjects, after being blindfolded, were touched at various places on the arm.

Each time (by means of an elaborate mechanical arrangement) they had to point at the place without actually touching it again. The results showed a tendency of all these localizations to drift more and more towards their *general centre*. Thus in the case represented by Fig. I, the stimulations were made along the forearm and hand. There ensued, as is obvious, a constant error towards the



centre of this region. In the case of Fig. II, the stimulations were made along the upper arm; and now the errors tended to the centre of this. In Fig. III, the stimulations were along the whole arm; and again the error tended towards the general centre. In the accompanying figures the dots show the actual places stimulated, whilst the cross-strokes are the average localizations.

Further instances where experiences regress towards immediately preceding ones would appear to be supplied by a large number of illusions, including those of the geometric-optical type. Commonly the passage from the

earlier to the later experience is so quick that the two seem to be simultaneous. This may be exemplified by the classical Müller-Lyer illusion:

Fig. 1

Fig. 2

The stem in Fig. 1 looks longer than the stem in Fig. 2, although really the lengths are equal. Possibly the origin of the illusion is as follows: the total length of Fig. 1 is really longer than the total length of Fig. 2. And this greater length, having been really seen in respect of the whole figure, is transferred in appearance to the stems.

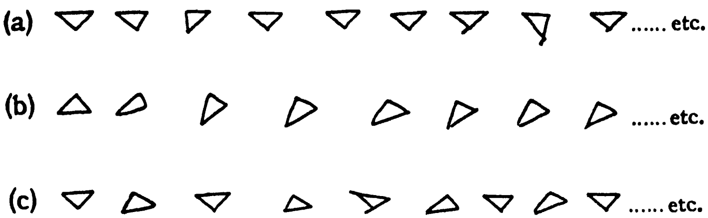
§ 6. *Resistance to Change*

Most significant of all would appear to be the difficulty attending abrupt switches over from one absorbing occupation to another. Such a difficulty seems to indicate some inertia in starting the new activity, or in stopping the previous one, or in both.

Many are the examples presented by ordinary life. Trouble may be felt when interrupting and then resuming a conversation; or when giving quick answers to unexpected questions. Embarrassment may be caused by unfamiliar place, occupation, or companionship. Very careful observations have been made of the difficulty experienced by many school children in passing from one kind of lesson to another (Bernstein).

But here also definite experiment has been busy. For one thing, it has established the time required for anyone to shift his attention voluntarily from one thing to another. This needful time, far from being fabulously brief as had been supposed previously, turned out to have the substantial duration of about a third of a second (Wohlgemuth).

Very much more, however, the research in this field has concerned itself with tests devised to measure the persistence under the name of "perseveration" (G. E. Müller) or of "secondary function" (Heymans and Wiersma). One of these tests, utilizing the phenomenon cited at the beginning of this chapter, has consisted in determining the number of revolutions of a colour-disc that are required to make its differently coloured sectors fuse together. Leading subsequent experimenters in this field have been Lankes, Bernstein, Wynn Jones, Stephenson, and Cattell. The following is an example given by Thomas:



> "A simple experiment in perseveration is to draw triangles as rapidly as possible base upwards (*a*) for exactly half a minute. When this has been achieved, another group should be drawn, apex upwards (*b*) also for exactly half a minute. When this has been achieved, one uninterrupted minute should be spent drawing triangles alternately base upwards and apex upwards (*c*). A measure of perseveration is then given by subtracting the number of triangles drawn in the last minute from the total of those drawn in the previous two half-minutes."

For further examples, and their discussion, reference may be made to Wynn Jones.

§ 7. *Need for Separate Law*

On the whole, we have in this chapter come across a large number of cases illustrating the rule that *every*

mental process lags behind the stimulus in beginning and much more so in stopping.

Can such a rule be regarded as a fundamental law? The suggestion might be made that this inertia could possibly be reduced to a special case of the facilitation discussed earlier. Or, more plausibly, both might be taken to be special cases of another law more general than either; one of bare Retentiveness.

In favour of this last view, of course, is its simplicity. Further, the two cases are often hard to distinguish from each other. Suppose a person reads a poem. At what moment shall we say that the effect on him is transformed from an unconscious persistence to a mere disposition?

But on the other side would seem to speak the analogy with physics. If mental facilitation is so aptly paralleled by folded paper, no less so is mental persistence by the dying-out of the vibrations of a tuning fork. And certainly on the physical side, the two states are fundamentally different and even opposite. The disposition, as we have seen, derives from imperfect elasticity; but the persistence, on the contrary, becomes greater as the elasticity is *more* perfect. There remains, then, a not unnatural suggestion that the two states are fundamentally unlike on the mental side also.

More important, however, than any such mere analogy with physics is the direct psychological evidence. And this, as we shall see later on (Part E), has been forthcoming. It speaks to the effect that the two are indeed as different on the mental side as they are on the physical.

§ 8. *Upshot*

Again we have to record much scientific progress. Common sense is indeed acquainted with some of the preceding manifestations, but only in a fitful and confused

manner. It has no notion of their instancing a general mental law.

Moreover, the law possesses, as we have seen, great practical importance even for general psychology. Possibly it has much more still for the psychology of individual differences.

On the formal side, too, including such qualifications as ultimacy and definiteness, the law appears to leave little to be desired.

CHAPTER XXXI

LAW OF CONTROL

§ 1. Formulation of Law. § 2. Application to Pedagogy. § 3. Application to Vocation. § 4. Application to Mental Tests. § 5. Application to Perception. § 6. Application to Reasoning. § 7. Control of Movement. § 8. Influence of Feeling. § 9. Upshot.

§ 1. *Formulation of Law*

So far (Chapters XXVIII-XXX) we have considered the law or two laws of Retentivity. But these, as we saw, cannot by themselves fully explain even bare reproduction. Still less can they conceivably account for all mental process. Where else shall we find any further explanatory influence?

An obvious appeal is to "attention". By attending to an object we gain a fuller acquaintance with it. Conversely, by discontinuance of attention, the supply of knowledge from it is caused to fade away. Here is seemingly a plain fact very well known to the plain man. But it appears to have become strangely confused since it fell into the hands of scientific psychology (Chapter VIII).

As was shown subsequently, however (Chapter XVII), the term attention could be replaced by, or defined in terms of, others which had suffered less from ill usage. In particular, it has been found to indicate a mental constituent which could be described as a seemingly forceful trying or striving, or "conation". Taken in this sense, attention aims at increase of knowledge.

We arrive at setting up—tentatively—a law as follows:

> "*The amount of cognition may be directly controlled by conation* (and therefore indirectly by resolution)." (See Chapter XVII.)

There are thus three phases. A person makes up his mind to listen (resolution); at the chosen moment he accordingly tries to hear (conation); and in consequence he actually may hear.

Some of the earliest indications of such a law may be found in the works of Plutarch. He brought forward many observations to show that a sensory impression is only realized as a perception when the mind is active in grasping its meaning. Somewhat more definitely, Augustine declared that the simplest apprehension involves volition.

§ 2. *Application to Pedagogy*

But, on the whole, this phenomenon has strangely failed to attract notice and excite interest in academic circles until very recently. Even now, we have to turn for abundant and striking examples, not to the psychologists who write text-books, but to those who deal with practical life.

An instance is at once supplied by education. Even in these days of the "soft pedagogy", where teaching is to be done without tears, the educator still in his heart realizes that by hook or by crook he has got to make the pupil "try".

Momentous too, besides the degree of trying, is also the manner of it. In the eloquent and profound work of Nunn:

> "Conation rises slowly from the level of blind or purblind impulse to that of clear-eyed desire, and eventually

> from the level of desire seeking an immediate good to that of will fixed upon a distant and perhaps ideal goal."

For many years, the present writer used to submit new university students to mental tests and then compare the results with their subsequent academic success. Particular notice was taken of those frequent cases where the test results were very good, but the academic work very bad. Almost every one of these cases could be traced to the same cause, namely, absence of the will to learn. The deficiency in the cognizing was really due to the weakness in the conating.

§ 3. *Application to Vocation*

From career in school and at the university, it is but a short step to the experiences of after-life. And here too we all know that an immense influence is exerted by how much the person really tries; his acts of will, his conation, or however else we may style it.

A dramatic instance of this fact can be derived from a consideration of acknowledged "geniuses". Three hundred of these—from Goethe, Newton, Descartes, and Kant, downwards—were submitted to an interesting study by C. M. Cox. Among the principal conclusions was the following:

> "Youths who achieve eminence are characterized not only by high intellectual traits, but also by persistence of motive and effort, confidence in their abilities, and great strength or force of character."

Much the same fact, but viewed from a somewhat different angle, would seem to have been intended in the following words of a friend of the writer:

> "In the making of a great man, one ingredient is a little hunger."

§ 4. *Application to Mental Tests*

From such instances which, however interesting, are not very amenable to exact investigation, we may now turn to the better-lit domain of experiment.

A valuable instance is the study made by T. V. Moore of Image and Meaning in Memory and Perception. He reports that:

> "Over and above the tendency of the images to recur, there is a factor in repetition which we may term the 'will to recall.' If the objects are to be recalled in the same order as presented, this voluntary effort exercises a certain selection in directing the order in which the words shall be named. . . . The recall, therefore, is in no sense of the word a purely reflex phenomenon, but the process is initialed and directed by voluntary effort."

Another instance is to be found in the work of Panicelli. This author used two groups of 120 children, each of the groups being made homogeneous in respect of age (8-13 years), sex, and intelligence. To group A, a story

Gain in Percentage Recalled due to Conation	
Concrete nouns . .	14·0
Abstract nouns . .	2·7
Pronouns . . .	8·0
Qualifying adjectives .	5·2
Demonstrative adjectives .	14·4
Verbs	20·5
Adverbs . . .	20·6

was read in such a way that they did not expect to have to recall it; hence the only conation in learning it was such as the story itself aroused. To group B, the same story was read, but the teacher definitely stimulated their "will to learn". Five minutes after the reading in each case the children had to write out as much of the story as

they could remember. The table shows the gain in the percentage of different classes of words recalled when learnt with much conation as compared with little conation.

Yet another interesting investigation, that of Mulhall, studied the influence of "determination to remember". Two groups of subjects were shown the same photographs and nonsense syllables, but one of the groups was specially instructed to look at each object with a determination to remember it.

The result was to show that the determination to remember

(*a*) Influences immediate recall but does not influence recognition.

(*b*) Produces greater improvement in reproducibility of names than of nonsense syllables.

(*c*) Strongly influences the number of first and last names correctly connected (increase of 147 per cent due to conation).

(*d*) Influences strongly the number of photographs and names properly associated (increase of 250 per cent).

Thus conation in learning has a greater effect on reproducibility when the material is rich in associations, and when there is no time allowed for repetitive facilitation. The reason is probably because the conation increases the cognition and so augments the number or strength of the associative links.

Much more recent and more important have been the researches made in this direction by Wild. Here the subjects were required to perform numerous tests of the so-called "intelligence". But in so doing an attempt was made

> "(1) To obtain a variety of common intelligence test forms.

" (2) To choose tests which required different degrees of conation for their successful completion.

" (3) To arrange that some of the tests requiring *great conation* should have the same form as some of the tests requiring *little conation*.

" (4) To obtain tests which would provide a wide survey of mental processes."

Further, the subjects were instructed to adopt the following different attitudes :

" *I. Tr.—the attitude briefly described as Tense-Speed.*

" Today you are required to use as much effort as you possibly can, this time trying to get as much of the tests done as possible in the given time. The time allowed will be told you before each test. You are not expected to be able to finish any of the tests in the time allowed, but you must use your maximal effort to do as much as you can."

" *II. Sr.—the attitude briefly described as Slack-Speed.*

" By ' slack ' here is meant you are to use as little effort as possible ; you are to approximate as nearly as possible to zero of your scale of effort. Do not try to work slowly nor to think of other things, but adopt the negative attitude of minimal effort—do not worry about speed ; it does not matter how little you do in the time, so speed does not concern you. Your object is to use as little effort as possible and let the results follow from this. You will be given the same times for the tests as when you worked as quickly as you could, but do not let these time-limits cause you to use greater effort. Remember today to try to keep your effort as near to zero as you can, and let the results be what they will."

" *III. Tq.—the attitude briefly described as Tense-Quality.*

" Today you are required to put as much effort into the tests as you can, directing your effort to making no errors and to doing the tests correctly. You can take as long as you wish to do the tests, so that speed is of no importance whatever. Your whole interest is accuracy."

" *IV. Sq.—the attitude briefly described as Slack-Quality.*

" By ' slack ' I mean you are to do the test with as little effort as possible. You must not *try* to work slowly nor

> *try* to think of other things. Rather adopt a negative attitude of minimal effort towards the task. Do not worry about how slowly you are working—you will have ample time to finish the tests and speed does not concern you. Do not worry either about how badly you may be doing. You will be given an opportunity to show what you can do when you try your hardest. Today just get the attitude of minimal effort and let the results follow."

In part of the work, aiming mainly at objective data, the subjects were university students and school children. But in addition, to get reliable introspection, some highly trained psychologists were induced to perform the same experiments.

Of the numerous results attained, the following two may be cited for our present purposes :

In the first place, the differences of attitude that were here induced in this manner made definite but unexpectedly small difference in the total performance. The chief result of intense conation was to improve the quantity at the expense of the quality ; and this occurred even when the order given was to make the quality the main object. For testers, this conclusion is very instructive, and in a way comforting.

Secondly, the amount of conation necessary for good performance does not vary with the kind of cognition at issue, but does vary in proportion to the complexity of the cognition involved.

§ 5. *Application to Perception*

Possibly less important in practice, but more significant in theory, has been an investigation made by Aveling.

His procedure consisted essentially in exposing to view, for a twentieth of a second each, groups of variously shaped and coloured symbols.

The various conations to be compared were again excited in the subjects by means of giving them correspondingly varied instructions. One, for instance, was to cognize as follows: "Observe all you can, and record what you see". Another was: "Look for a given symbol (or relation), and record all you see".

The experiments showed that the conation influenced the cognition in all its phases. When the instruction was to look for some given object out of several presented, then the consciousness of that object gained in intensity and accuracy at the expense of the others. When the instruction was to perceive some relation between different objects, then the presentation of this relation made similar gains. And analogous were the results when the subject was given an item together with a relation and instructed to think of the correlative item.

Besides all these quantitative results, Aveling's research produced a great deal of qualitative information; particularly with regard to the part played in the cognition by subconsciousness.

The work was followed up and greatly expanded in another research carried out under his direction three years later by Mercer. Here are some of her results:

> "1. The effect of intentional set, as compared with general observation, is to cause a substantial gain in the likelihood of the required items, relations or correlates being perceived and recorded.
>
> "2. To look for a particular item, relation or correlate causes no significant decrease in the total amount perceived and recorded, the span of apprehension remaining substantially unaltered.
>
> "9. Within limits of cognitive span, the amount of gain through special intention tends to be greater for more difficult perception, that is, when original expectation is lower.
>
> "10. There are apparently optimum conditions for the effective exercise of volition in the direction of perception.
>
> "The effect of intentional set, as compared with general

> observation, is to cause a substantial increase in the likelihood of recording the required items, which apparently become meaningful by virtue of their capacity to satisfy the need artificially created in the individual and to release the tension implied by the set, through which mental energy is held in check pending liberation in a satisfactory mode of activity."

Above all, Aveling finds ground for generalizing; he extends his conclusions, not only to the behaviour of all human beings, but even to that of animals.

§ 6. *Application to Reasoning*

Along very different lines has been the research of Menon, which sought to discover the nature of the mental processes involved in "reasoning". One set of experiments was made on the following lines:

> "The subjects were given a complete example of what the logicians call an immediate inference, as for instance: 'If all A's are B's some B's are A's.' Modified forms of this statement by variations of quantities of the terms were also presented. Thus the forms—If no A's are B's no B's are A's, or If all A's are B's some A's are B's were also among our material. The subjects were sometimes given only one proposition such as no A's are B's and asked, 'How many propositions can you conclude from this?' 'What are they?' 'Describe the mental process.' Instead of symbolic terms A's and B's, officers and soldiers were substituted and thus propositions like 'If all officers are soldiers some soldiers are officers' and quantitative modifications of it were tried. With each example there was an instruction either to give the general mental process occurring or to answer special questions or sets of questions on imagery, relations, eduction, reproduction, certainty, insight, mediation and various other topics examined in these pages."

Now although this investigation was mainly directed towards cognitive processes, still some very important

results were incidentally obtained about the orectic ones. In particular, Menon remarks as follows:

> "Effort is used not in the actual eduction (i.e. the essential act of reasoning) but in the 'getting of the terms into position'—'a setting of the stage.'" . . . "The actual eduction is spontaneous and so is the insight that accompanies it. It is also found that very often different methods are followed at this pre-eductive stage, leading to differently constituted relational systems being built up, but the actual eduction itself is the same for everyone."

The same point is again stressed by the author as follows:

> "Conative effort has been seen to be necessary in both eductive and reproductive methods, and considerable individual differences noticed. The actual cognitive process of eduction was found to be spontaneous and outside the realm of effort, effort being ineffective there. Yet considerable time and effort seem to have been expended, also subjects have complained of the hardness of the task and of the great fatigue involved. We have not studied the nature and causes of these factors, but it seems nevertheless that non-cognitive factors are more important in this connection than cognitive ones. We have indications that effort and time are used in the conquest of mental inertia or resistance mental or emotional. Greater or less effort, longer or shorter time is not involved in the actual cognitive and eductive, but in the pre-eductive period. Reference has also been made to the essential nature of the incubatory period. The individual differences in time and difficulty would seem to depend on the setting of the stage, which, in turn, is dependent on conational and affective factors."

§ 7. *Control of Movement*

So far in this chapter we have considered only the control of cognition. But even more obvious to common sense is the control of movement. Nothing can be plainer to the man in the street than that when he eats,

walks, talks, fights, flees, and so on, a great many of his movements are voluntary; they derive from his acts of will; they occur because he tries to make them do so.

But such a universally accepted fact offers to the psychologist a correspondingly attractive chance of being original—by denying it. He can say, and has said, that such acts of will never happen. In their place, as seen above, several authors have desired to substitute the wonder-working process of association. But other authorities have devised another and more constructive doctrine. There arose, under the leadership of Charpentier and Ribot, what has been called the ideo-motor theory. According to this, a movement was directly caused by an idea or image of it; in fact, *all* states of consciousness were credited with some such ideo-motor tendencies.

But eventually this problem too was rendered amenable to experimental investigation, notably in 1901 by Bair. The muscle selected by him for study was the *retrahens* of the ear. This with most people cannot be contracted voluntarily, but readily enough by electrical stimulation. He found—unexpectedly enough—that the voluntary movement could not be acquired, or even helped, by any amount of practice at inducing the movement by electricity. But it could always be acquired by attempts at the voluntary movement if only these were continued long enough.

The explanation given was as follows:

> "In this stage the retrahens is always contracted by biting the jaws together or vigorously raising the brow. The ear was thus first reached by innervating a group of muscles over which one had already control."

> "Attention is the all-important thing. This sensation which satisfies the effort of the will, i.e. the one attending the contraction of the retrahens, becomes the thing upon which the attention is focused."

"As the energies are now more definitely centred on the reproduction of the specific sensation of the movement originally sought for, more and more of the motor impulse is directed through the channel which produces this desired sensation, and continually less leaks out through the old channels, until eventually the whole impulse is so directed as to produce specifically the movement desired, and this is *voluntary* control."

He concludes:

"We cannot do better than accept the general hypothesis that the child begins its existence with a profusion of random movements which have no definite adjustment and no fixed relation to the stimulus, but which serve to bring into play the voluntary motor mechanism and supply consciousness with experience and thus constitute the psychical initiative to voluntary movements."

"Any part of this diffused discharge, or of the movement produced by the discharge, which effects the gratification will immediately attract to it the attention and consequently as the process is repeated will gradually appropriate more and more of the general discharge."

The same topic was soon afterwards taken in hand by Woodworth, according to whom there had before him been two main theories of voluntary movement:

"(1) The 'narrower view' by which the mental content directly concerned in causing the movement is always a kinaesthetic image, a picture in 'muscular' and perhaps also tactile terms of how the movement is going to feel."

"(2) The 'broader view' is that any sort of image of the results to be gained by the movement may become associated with the movement and constitute its only cue."

But from his own research he arrived at a third view. This was:

A denial "that any form of sensorial image of the movement, or of its outcome, need be present in consciousness in the moment just preceding the innervation."

Of the later experimental work we may especially name the investigations of Van der Veldt and of Bu on *The Automatization of Voluntary Movement.*

The chief result of Bu (working under the direction of Aveling) was as follows:

> " Learning in our research was found to consist in the growth of insight on the conscious level and of the organization of the movement on the behaviour level. As the instruction, the insightful apprehension of the stimulus was followed by the organized movement. Once the insight into the goal was clear and definite, learning had taken place. Repetition served only to facilitate the development of insight."

A further investigation (under the same guidance) has been that of Philp on *Frustration.* The author reaches, among others, the following chief conclusions:

> " 1. Phenomenologically, Frustration consists of two aspects:
>
> (1) A confused experience of conative effort.
>
> (2) Increased emotional experience. This appears to be an outlet when activity is blocked in other more productive directions.
>
> " 2. Frustration does not imply that the ' will to solve ' is necessarily lessened."

And so it would seem that here again the achievement of the psychologists has been doubled. First, there was an upsetting of common sense; and then came the success of re-establishing it—with, be it understood, valuable additions.

§ 8. *Influence of Feeling*

Besides the control of cognition and of movement by the will, we have also to consider the influence exerted by feeling. And here we have in mind its *direct* influence; not that which it may have through affecting volition.

Obvious enough are, at any rate, some effects of feeling on the body, such as invigoration of the muscles, changes in blood-pressure, and altered glandular secretions. Among effects on the mind, two that are often alleged consist in a heightened flow of ideas, and a "stamping in" an action in such wise as to prolong its occurrence and promote its recurrence.

But at this point we must break off. The facts seem to have been so little submitted to exact investigation as to make any attempt at precise formulation of a law illusory and futile.

Little study has been made even of such fundamental questions as the relation between volitional stimulation and volitional inhibition. Are the two powers essentially different or the same?

§ 9. *Upshot*

Evidently the preceding cases of orectic control stand on a much inferior footing to that of association, or even that of dispositions. They more resemble that of inertia. In certain aspects and in an obscure manner, they have indeed been strongly realized even by common sense. But up to the most recent times, scientific psychology has added little more than damaging exaggerations.

Nowadays, however, there appears to have commenced an effective study of some of the main facts at issue, and within this limited sphere, at any rate, the formulation of scientific laws would seem to be feasible enough.

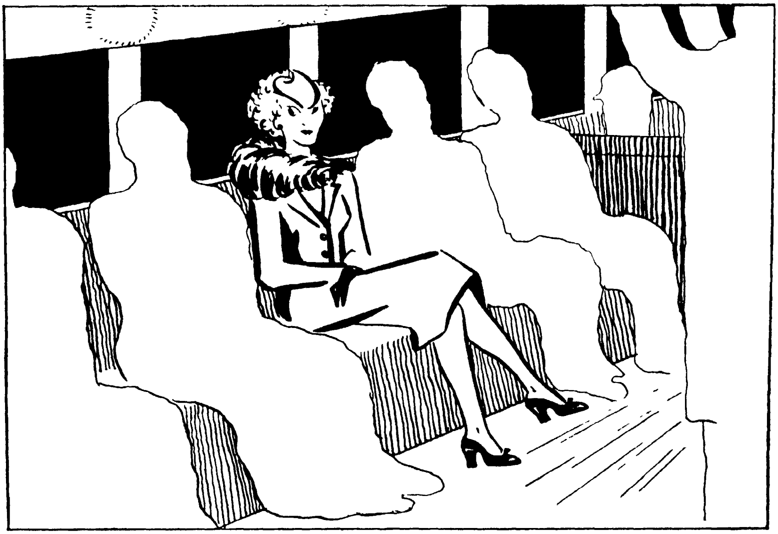
CHAPTER XXXII

LAW OF CONSTANT OUTPUT

§ 1. Back to " Attention " again. § 2. Law of Simultaneous Perception. § 3. Extension of the Law throughout Consciousness. § 4. Hypothetical Energy. § 5. Alternative Theories. § 6. Practical Application. § 7. Neglect by Psychologists. § 8. Upshot.

§ 1. *Back to "Attention" again*

We commenced the preceding chapter by citing the familiar experience that a person can become better



acquainted with an object by "attending" to it. Let us turn to the no less certain fact that this increase of information about the one object is in general at the cost

of decrease about others. Thus, no person can really see more than a limited amount even of what lies before his eyes. As it has been said, his vision has a limited "span".

This much is well known even to the plain man, as may be inferred from the preceding sketch, whose truth is recognized by everyone.

As further evidence of the ancient recognition of the same phenomenon, may be quoted the classical adage:

> "The sense intent on many things is less for each singly."

To be intent and to attend mean, or used to mean, much the same thing. And so we are back at the word "attention" again.

But although this same word has been confusedly applied both to conative control and to narrowness of span, the two things are far from really being identical. They not only differ in their respective essential natures, but furthermore depend on very different conditions.

§ 2. *Law of Simultaneous Perception*

Consulting history about the phenomenon, we find that note was first of all taken of the interference between different items of sensory perception. As the beginning of the business we may take the following momentous passages of Aristotle:

> "By a single sense we cannot perceive two objects unless they combine with each other. . . . Since sweet is opposed to bitter, it is impossible to perceive them simultaneously. . . . Neither can composites be simultaneously perceived unless as forming a unity, for they are proportionate combinations of opposites, e.g. chords of the octave and of the fifth. . . . But certainly when objects of the same sense, if dual, cannot be simultaneously perceived, it is clear that still less will this be possible in the case of objects of two different senses, e.g. white and sweet."

But with these passages the fat was in the fire, or at any rate on its way there. For they introduced what we have already found to be a deadly pitfall, the little word "unity" (see Chapter XV). And this eventually called down—though it took about eight hundred years more to do so—a violent and never-ending controversial storm. The Aristotelian view was fiercely contested. The opposition to it was begun in a very remarkable manner. The following theorem, clearly approaching the form of a law, was laid down by Nemesius:

> "Vision alone never perceives the number of the objects in view if this number is more than three or four. When the number is greater than this, the perception of it is not confined to a single view, but brings in memory and thought. Vision is similarly restricted in the case of perceiving movements and many-angled figures."

Especially remarkable about this formulation is its cautious reserve. It not only confines itself to sensory perception (and that, only visual), but furthermore restricts itself to three items of information, namely, number, movement, and angle. Vision, it declares, does not directly perceive the number of such simultaneously displayed objects if this number exceeds three or four. What else it does or does not perceive is guardedly left unsaid.

But what the law thus loses in scope it gains in exactitude. Its sharp delimitation seems to indicate that it was established by a method substantially experimental. In fact, it may be credited with constituting the very first experiment in all psychology.

Subsequently, and throughout the Middle Ages, this problem of simultaneous perception excited the keenest interest. But in form it went back from Nemesius to Aristotle. The question ceased to be about the perception of number, movements, and angles of simultaneously seen objects. Instead, it asked once more whether the

mind can understand more than one thing at the same time.

A millennium and a half seems to have been needed for the matter to be submitted further to experimental verification. The credit belongs apparently to Bonnet. He reports that the field of simultaneous clear vision embraces five or six objects such as points or as sides of a figure.

Yet another century had to lapse before the experiment was repeated and verified, by Hamilton with marbles, and then by Jevons with beans.

Very soon afterwards, however, experiments on such perceptual span became very numerous and assiduous indeed. This occurred in the inspired atmosphere of Wundt's psychological laboratory, and in the hands of many eminent investigators. But now the fact of several objects being simultaneously clear was ascertained by a new method. Formerly, it was simply judged by way of introspection. But in the modern work, the simultaneousness was secured—or hoped to be so—by displaying disconnected objects (as lines, letters, or numbers) for so short a period as to prevent the attention from shifting; the period of exposure was generally about a fiftieth of a second. The subject then had to say how numerous the objects had been. With practice, J. Cattell found, a correct result was possible up to six objects; no more.

Further research gave similar results for the senses other than visual. Thus Krohn found the number of distinguishable simultaneous touches had the same maximum of six. A fact, by the way, that has determined the construction of letters for the blind. Again, Quandt discovered the same maximum for the numbers of successive evenly distributed taps that could be clearly apprehended as a whole. In general, this optimal maximum of six would appear to be a constant.

Over and above this dominant problem of how many

objects can be seen at the same time, the modern experiments have made several contributions less well known but even more interesting. Thus, Flugel has shown that the span of vision is analogously narrow when the separate visual objects are replaced by a single continuous design (for bearings of this discovery, see p. 96). And he finds that the same is true when the act of perception, instead of being momentary, is indefinitely prolonged.

Some other modern work has been devoted to the question as to how far the clearness of objects is a matter of degree. Lotze denied this. Others, as Titchener, have reported that it has only two grades, i.e. clear and unclear. But the great majority have held—in good accord with common sense—that this grading is continuous from a central sharp focus to an increasingly obscure periphery.

Yet another point which has attracted some modern notice—but not nearly enough!—is as to whether and how the span can be made larger. The conclusion has been reached, in part on experimental ground, that the number of simultaneously clear objects becomes much larger when these are interconnected into "a familiar whole". But these modern experimenters seem to have been less careful than old Nemesius in taking account of what is "brought in by memory and thought".

There seems to be much need of further investigation.

§ 3. *Extension of the Law throughout Consciousness*

Up to now, we have only treated of the narrowness of the span in the case of sensory perception. But in point of fact there are abundant indications of the phenomenon having a far wider scope.

And not a little of this extension would seem to have arrived at the cognizance even of the plain man. He realizes well enough that his sensory percepts not only

interfere with one another, but also with his thoughts. Witness the trouble of anyone trying to think when someone near by starts hammering nails or playing music. Reversely, everyone knows that he may fail to perceive objects because of thinking about something else. Nor has it escaped popular notice that the mutual interference extends even to the sphere of the emotions. Not everyone, perhaps, can, like Pascal, let mathematical study banish a toothache. But many will let toothache impair mathematical study. Here, too, may be quoted the familiar saying of Publius Syrius :

> " To do two things at once is to do neither."

Turning from common sense to psychology, something of this wider scope of the phenomenon of span—at any rate with regard to cognition—is already foreshadowed in Aristotle's celebrated dictum, that " one can know many things but understand one alone ". And certainly this ancient sage realized the immense disparity between the whole knowledge possessed by anybody (ἡ ἐπιστήμη) and that actually employed by him at any particular moment (τὸ θεωρεῖν). But this contrast seems to have lost most of its point by being indiscriminately merged into his more general distinction between the " actual " and " potential ".

Much more advanced was the teaching of Buridan, that the increase of one feeling causes decrease of others.

But for the first definite expression of the law of constant output in its full universality we seem to have to wait for Malebranche. He daringly wrote as follows :

> " The soul of man has, so to speak, a determined quantity or a portion of thought, which has limits which it cannot exceed. The soul cannot become larger or more extended than it is. . . . In fact it seems to me that it (the soul) *never perceives more at one time than at another.*"

To appreciate the extensive scope of this theorem, we

must remember that for him—as for Descartes before him—" thought " (*pensée*) included not only all cognition, but also all feeling and all willing.

In support of his position, as also in rebutment of attacks upon it, he managed to advance an array of arguments. For one thing, the mind must needs have a limited capacity because the body has one. Again, although a person does sometimes think of many objects and sometimes of only one, yet in the latter case he tends to think more clearly. Yet again, he may admittedly upon occasion think of even a single object unclearly; but then, Malebranche says, the mind is occupied by something else, some vivid pleasure or pain, or perhaps some multitude of feeble sensations, as occurs in states of dizziness.

§ 4. *Hypothetical Energy*

The passing of another century or two brought about a further fundamental development. Like all the other laws of mind, that of constant output received vital inspiration from the progress made in the laws of physics. The success of Newton soon led such writers as C. C. Schmid to consider the feasibility of tracing all the manifold manifestations of consciousness to one single fundamental *force*. And only a score of years after the chief publications of R. Mayer and Joule, we find Immanuel Fichte declaring with entire confidence and perfect definiteness that all mental processes and changes derive from

> " the great principle of the so-called conservation of energy, amid change in mode of manifestation."

This mental energy or force, be it observed, is like the physical kind in that it can never be more than hypothetical. When Joule was supposed to have discovered

that the energy of movement was transformed into that of heat, all he really found out was that, when a certain amount of movement disappeared, then some constantly corresponding amount of heat appeared ; in other words, he actually observed a constant *equivalence* between the loss of movement and the gain of heat. The " force " was only an after-thought. Obviously, the case is totally different from that of willing where force, rightly or wrongly, does seem to be actually observed (see Chapter XVII).

But how shall any such equivalence be established in respect of the mind ? One answer, at any rate, was half a century after Fichte's day supplied by Lehmann. He selected for his study a case where one kind of work was first executed alone, and then together with another kind. The former work consisted in pulling up a weight (using the ergograph familiar to experimentalists). The other and additional work consisted in doing some arithmetic. He found that whilst the calculation was being done, the height to which the weight could be raised became smaller. Such a decrease of the work done in pulling could be regarded as the equivalent of the work imposed in calculating. But this calculating can evidently be replaced by any other kind of mental activity. For each, apparently, it is possible to measure the equivalent in one and the same standard of comparison, that of raising weights. So far, then, the determination of the expenditure of mental energy would seem to stand on the same level as that of physical energy.

But the critic may still inquire whether such determinations attain to the status of genuine measurements, which can be expressed in exact formulae, and thus afford a precise answer to the question as to whether the output of energy is really constant.

Even this problem was undertaken by Lehmann. He likened his mental case, that of first pulling alone and then

whilst also calculating, to the physical case of a stream of water flowing, first through a single exit, and then also through a supplementary one.

Now in the case of the water, he proceeded to argue as follows. Let S measure the amount of work done at the first outlet *before* the second one is opened, whilst V is the amount done at this first outlet *after* opening the other. Then from the known physical laws of constant output he derives the conclusion that:

$$\frac{S - V}{S}$$

will remain constant for all different values of S. This formula he proceeded to verify in two experiments as follows, when S was first 91 and then 76:

	S	V	(S – V)/S
Experiment I . .	91	68	0·25
Experiment II . .	76	58	0·24

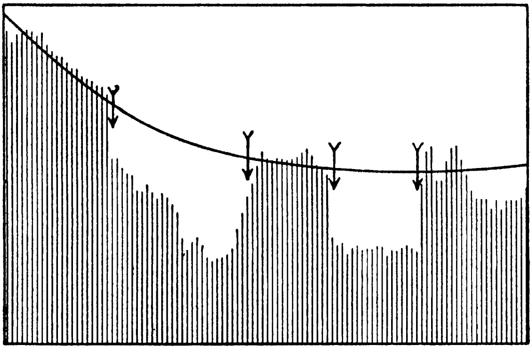
The agreement between 0·25 and 0·24 can be regarded as good.

Turning now from the physical case to the mental one, we can take S, the entire height to which the weight is raised originally, as measuring the entire mental energy when this is all expended in the effort of pulling. Similarly, V measures the portion of mental energy expended in pulling when some of it is diverted into the calculating. Thus S – V measures the amount which is diverted. In order to obtain in this mental case different values of S parallel to the physical differences, Lehmann selected different parts of one and the same work-curve; the first part being near the beginning, when the worker was fresh; the second part being near the end, when he was tired.

If now, the mental effort really resembles the water-pressure in remaining constant during the two experiments, then in the mental case also there should be

constancy in some such formula as (S - V)/S.

Several such experiments were tried, with unequal degrees of success. Some agreed with the theoretical formula almost as well as did the physical results, whereas others showed much larger discrepancies. In general, however, the agreement proved to be as good as was to



LEHMANN'S WORK CURVE (SMOOTHED)

be expected in view of the experimental difficulties. A fairly typical result was the following :

	S	V	(S - V)/S
Experiment I. Unfatigued part of Curve	160	73	0·54
Experiment II. Fatigued part . .	105	40	0·62

The actual work curve is reproduced by the vertical lines in the figure above. The two arrowheads on the left indicate the beginning and the end of Experiment I, whilst the two on the right mark the beginning and the end of Experiment II. The curved line represents the general course of the motor activity when done alone. The sinkings of the vertical lines below this curve show how the impaired motor activity was impaired when done simultaneously with the reckoning.

On the whole, Lehmann concluded that the decrease of the muscular work caused by the simultaneous mental work

> " indicated exactly that fraction of the free energy of the brain which was consumed by the said mental work."

Suppose, now, the arithmetical work to be replaced by any other mental performance. The diminution of motor power could be measured in just the same way. And thus eventually all the mental processes would reveal their respective equivalents in terms of one and the same motor standard. Unfortunately, Lehmann did not live to carry out this great programme. However, soon afterwards another eminent psycho-physicist, Wirth, made a fresh attempt at demonstrating experimentally that

> " all the results indicate one constant limited sum total of mental energy."

His method consisted in dividing the visual field into a large number of areas, and measuring the person's power of perceiving changes of brightness in different areas with differently distributed "attention". And he, too, verified the law.

Whatever criticisms may be made on points of detail, these investigators, together with J. Cattell, seem at least to have demonstrated—contrary to almost universal assertion—that the theory of constant output does admit of application to mental processes, at any rate *in principle*.

However, the question may well arise as to whether this output might not be better expressed in terms of "power" rather than of "energy". Conceivably, a normal adult could be said to possess, not a "mental age" of so many years, but rather one "mind-power".

§ 5. *Alternative Theories*

For a moment, however, let us suppose that this hypothesis of one general energy breaks down. What further theories of the limitation of mental span have ever been conceived instead, or by way of supplement?

Earliest, most enduring, and yet perhaps least tenable, has been the insistence that the mind grasps only one object at a time because it is itself only one thing. But this view forthwith breaks down on the fact already noted, that unity is no objective character either of the mind or of its objects, but only a subjective manner of regarding them.

To boot, the view implies that the mind and its object must be alike. Why should we not equally well assert that he who drives fat oxen must himself be fat, or that when a man thinks of death, he is dead himself?

Somewhat subtler is the view which has been frequently taken that the mind, being only one thing itself, can only "attend" to one object. But here is a happy disregard of the experimental finding, that *more* than one object—in fact, up to five or six—can be seen clearly at the same time. Nor is any notice taken of the proof supplied by Flugel, that only a portion even of a single object can be seen clearly, if it be complex.

More reasonable would seem to be the early explanation suggested by the Stoics and preserved to this day in the very word "attention", which indicates some sort of tension or strain. According to this view, the facts we have been considering are explained on the ground that a person can only apply to his intellect some limited amount of "tension".

It is interesting to note that nowadays, when the attempt to explain the span by any such tension has become obsolete, and when consequently the word "attention" has become meaningless, its usage—both by the psychologists and by the plain man—remains as common as ever. When an idea is lacking, a word may still be a convenient substitute.

Even more curious than the explanation of the Stoics was that of Descartes. With him the physical tension as of a spring was replaced by the physiological agency of one

small gland in the brain. This was supposed to guide the " animal spirits " towards the object attended to.

The suggestion of Malebranche was more commonplace. He seems to have regarded the intellect as being merely some sort of container or receptacle, which is always kept full to capacity.

Nowadays, the psycho-analysts have contrived to find a substitute for the term " energy " in the old Latin term "*libido*", which has the advantage (for them) of suggesting that all mental action has really a sexual character.

McDougall has instead followed Lehmann in taking mental activity to occur along lines analogous to the flow of water through a system of pipes. But now the analogy is developed with such ingenuity and in such detail as to constitute a landmark in the theory.

Most recent, and physiologically most important of all, is the concept advanced by Lashley of "mass action" or " mass function ". He brings forward evidence in favour of

> " a law of mass action whereby the efficiency of performance of an entire complex function may be reduced in proportion to the extent of brain injury within an area whose parts are not more specialized for one component of the function than for another."

Now, all the preceding theories of mental span, although they depart more or less from Fichte's pure analogy with the energy of physics, nevertheless seem still to harmonize with the observations of constant output. But yet another theory has been proposed, and one where the harmony becomes at least dubious. This time, the fact that the appearance of any items in consciousness coincides with the disappearance of other items is no longer attributed to any general competition of all items for one and the same tension, receptacle, energy, waterflow, or mass action. Instead, the reason for any different

items not appearing simultaneously is ascribed to their being specifically antagonistic to each other; much as bending one's arm is opposed to stretching it.

Some such specific antagonisms seem to have been already suggested by Herbart. For, according to him, any opposite ideas, such as sour and sweet, strive to exclude each other from consciousness, whereas non-opposite ideas, such as a tone and a colour, make no such mutual resistance. But then he quite changes the doctrinal aspect by introducing an additional theorem. All the mutual resistances of opposing ideas are said not to be independent, but instead to be governed by a general principle, namely, that the amount of ideas kept out of consciousness should be the smallest possible. And in this fashion he comes back after all to much the same actual result as Malebranche and Fichte.

Somewhat similar, save for its physiological form, appears to be the specific opposition proposed by Sherrington a hundred years later. By him, "the great psychical process of 'attention'" seems to be based on "the interference of unlike reflexes and the alliance of like reflexes". One wonders whether he too has not some saving clause whereby harmony with psychological observation can be re-established.

There is one more important alternative theory. It is that of Wundt, who would derive the limitation of simultaneous activity from the existence of a general inhibitory centre (located behind the forehead). But this view seems now to be generally abandoned.

§ 6. *Practical Application*

Turning from theory to practice, it may be noted that there are very numerous cases where the law, even if not definitely formulated, is nevertheless obviously put to extremely important actual use.

Such cases are of two general kinds. The one is where something desirable has to be promoted, by concentrating all available energy upon it. The other is where something undesirable has to be hindered, by withdrawing energy from it.

The first kind embraces particularly acts of cognition. The whole scheme of human behaviour follows the principle of assisting perception, thought, and action by not requiring these to do too much simultaneously. In normal conversation, only a single person speaks at a time. If one hand is engaged in writing, the other does not attempt to start drawing. The more difficult the job, the more rigorously all other activities are suspended. Whilst a man is aiming a decisive shot on the putting green he does not expect anybody to make so much as a whisper. One of the main principles of education is not to fill the mind of the pupil with an excessive amount of content at the same moment. This universal principle of behaviour is perhaps most evident when *not* followed; for instance, the amusing case, when a child five years old required someone to tell him two different stories at the same time.

The second kind of practical application of the law, that where some item of consciousness has not to be favoured but repressed, is generally less of cognitive than of orectic nature. For instance, every mother knows that when a child hurts himself his pain may be lessened by making him think of something else. Throughout life the most generally serviceable remedy for harmful emotions or volitions is found in diverting the person's energy to hard work. Here we may perhaps include much of what is modernly called "sublimation". Allied is the policy suggested by the saying, that Satan has ever mischief for idle hands to do.

And if this law of constant output is at least encouraging on the score of its power of foresight and control, still

less does it fail on the other great scientific requirement, that of being fundamental. For never, it would seem, has any serious attempt been made to resolve it into other laws of greater generality. As regards the charge sometimes made against it of not constituting a law, since it asserts only a " tendency ", not a regularity, this is a point that affects all the laws alike and will be considered later on (Chapter XXXVI).

§ 7. *Neglect by Psychologists*

In view of the obviousness and practical importance of all these facts about mental output one might naturally expect it to supply one of the chief themes for psychologists. And so it has done for some. But these have been a strangely *small minority* !

Throughout far the greater part of history, interest was confined to the single and ill-conceived problem involved; that is, as to whether more than " one " thing can be understood at a time.

Even when in modern literature the scope of the facts taken into consideration does become wider, it still remains with most authors amazingly defective.

As for any endeavour to treat the facts with scientific precision, this has been scarcer still. Everywhere the chief problems have remained almost untouched. How far does the whole phenomenon of span extend ? Does it go down to subconscious activities ? Do all the cases belong fundamentally to one and the same general order, or to several different orders ? Where and how is the distinction to be drawn between general competition and specific antagonism ? When equivalents are at issue, what are their respective magnitudes ? With what advantages and disadvantages can observed equivalents be supplemented by unobservable hypothetical entities ?

§ 8. *Upshot*

In the phenomenon indicated by the phrase " constant output ", we appear to have reached the material for yet another mental law. Stripped so far as feasible of superfluous hypotheses, it may be formulated as follows :

> *Every mind tends to keep its total simultaneous output constant in quantity, however varying in quality.*

Even the plain man, although he does not explicitly formulate any such law, yet always behaves in such a manner as to imply at least some crude awareness of it. And a comparatively very small number of psychologists —mostly in quite recent times—have arrived at bringing it to definite expression. In itself, it would appear to have all the characteristics of a genuine scientific law. But so far its verification and study, as compared with those of the laws of retentivity, have been lamentably deficient. In respect of exploiting it, indeed, psychological science is rather behind than ahead of popular practice.

CHAPTER XXXIII

LAW OF FATIGUE

§ 1. The Paradox. § 2. Practice and Fatigue. § 3. Effect of Rest. § 4. Effect of Volition. § 5. Effect of Change. § 6. Alleged "Law of Relativity". § 7. Case of Catharsis. § 8. Oscillation. § 9. Explanation of Fatigue. § 10. Application of the Law. § 11. Upshot.

§ 1. *The Paradox*

Is there anything more? We have had the law of Constant Output, by virtue of which the psyche is supplied with a certain amount of energy. Then there have been the laws of Control, whereby the energy has been variously distributed. And further, there has been the law of Retentivity, whereby every manner of distribution makes its own recurrence easier. What remains?

At least, there has still to be considered a further law which is opposite to the preceding one. It is to the effect that *every activity makes its own recurrence more difficult.*

Several critics—including some who ought to know better, as the *Oxford Magazine* and the *Cambridge Review*—have found the relation of this law to that of retentivity a stumbling-block. What is really but opposition they have taken to be contradiction. They have not noticed that the same thing occurs even in physical science. For example, a particle of matter is described as being at the same time attracted and repelled.

The fact is that all laws are at bottom only abstract tendencies, into which the real natural event is artificially broken up. There is nothing to prevent different tend-

encies from more or less neutralizing each other. This fact, too, is quite familiar to the plain man. At one moment he thinks and talks of himself as proceeding in his ship to America; but the next moment he regards himself as pacing up and down the deck.

Indeed he is well acquainted even with the particular abstraction here at issue. He calls the increasing difficulty by the name of fatigue. For it, moreover, he entertains the liveliest interest. This mostly takes the form of aversion from what he regards as doing too much work. One field where this excess has been particularly feared is that of education. Mosso, for example, luridly depicts the "consequences of mental overpressure in children" as follows:

> "Disturbances of vision and especially short-sightedness. Cerebral congestion resulting in headache. Bleeding from the nose and vertigo. Tendency to round shoulders. Loss of appetite and indigestion. Predisposition to pulmonary affections. Spinal curvature. Cerebral disorders. Nervousness. In girls, disturbances which manifest themselves in irregularity of menstruation."

Even more momentous have been similar considerations in the spheres of industry and sociology. One of the principal planks in most schemes of social reform is always the shortening of the hours of labour. And among the chief supporting arguments is the belief that their present length produces excessive fatigue. Herewith the cry goes back to Marx, who wrote in 1892

> "that our inventions have not diminished human fatigue, but simply the price of commodities; that the machinery has rendered worse the condition of the worker, because by rendering strength of no avail it has entailed the employment of women and children; instead of shortening the working-day it has prolonged it; instead of reducing fatigue, it has rendered it more dangerous and injurious."

Curiously enough, however, the reduction of efficiency

through continuance of work is by the plain man—and indeed also by many psychologists—not regarded as a psychic phenomenon at all, but as purely physiological. Why? Because it has a physiological foundation? This can hardly be the real reason. For a no less physiological basis is normally ascribed even to processes which are accepted as being psychological by everybody; such as those of associative recall. Is then the reason because in the case of fatigue the physiological side of the event is known, but not in the case of retention? In truth, both cases alike can show some plausible physiological suggestions, whilst neither has much that is certain. Or shall the alleged ground be that the fatigue can at least be credited with an important physiological sequel? Why, so can *every* kind of psychological event.

Or can it be maintained that the phenomenon of fatigue, whether or not technically mental, has small general psychological interest? On the contrary, it has shown itself to be of the greatest importance in many psychological fields, as widely different as work-curves, abreaction, and the so-called "law of relativity".

Altogether, then, the usual endeavour to exclude fatigue from the sphere of psychology would appear to lack all serious justification. We here propose to take the contrary attitude. The results obtained by psychologists will be recorded on quite the same footing as those recorded with reference to the preceding laws.

§ 2. *Practice and Fatigue*

As a result of the aforesaid prejudice, fatigue found little or no mention throughout the whole range of pre-experimental psychology; with the partial exception of Herbart. Even the learned Hamilton as good as ignored it; so too Bain, for all his wealth of application of psychology to practical life.

With Wundt and the experimental methods, however, a great change came over the scene. One of his most eminent pupils, Kraepelin, brought the topic to the forefront of investigation. His subjects carried on for about an hour some sort of work that was so far as possible uniform, especially in respect of difficulty. At short intervals, commonly about five minutes, a record was made of the amount performed. All these records were then plotted on paper, and so constituted a "work curve".

At once the experimenter encountered the technical difficulty that, whilst any subject's output might be losing from fatigue, it could also be gaining from practice. Thus, the actual work curve was found to admit of resolution into two distinct and opposing components. The relative weights of these two—and therefore the shape of the whole curve—presents large variations from case to case. Practice influences work most where there has been least practice beforehand. Fatigue, on the other hand, depends on difficulty.

Further, the influence of the practice itself can be divided into two parts. The one consists in a change of procedure. The subject, as he continues his work, learns to do it in a more and more effective manner. Experiments on fatigue have been so devised as to reduce this part-influence to a minimum. Kraepelin, employing such simple work as that of continuous addition, seems to have thought he could treat it as negligible. There remains the other part-influence of practice, that where the subject's procedure does *not* change. This Kraepelin further divided, and into three elements; it fell for him into "exercise" (*Uebung*), "habituation" (*Gewöhnung*), and "incitement" (*Anregung*). Of these, the exercise was described as mainly consisting in the formation of associations. The habituation was identified with what occurs in ordinary life when a task after a time "confronts us as something known and customary".

It would seem to consist mainly of a mental "set" to act in some given manner. And the incitement was for him a strain of attention (*Aufmerkamkeitsspannung*), which seems to be another kind of "set", this time more conative than cognitive.

Both the exercise and the two "sets" would appear to fall within the scope of the law of retentiveness considered by us already (Chapters XXVIII-XXX). The fatigue, on the other hand, is something new. None of the laws that we have so far considered appear to account for it in any degree.

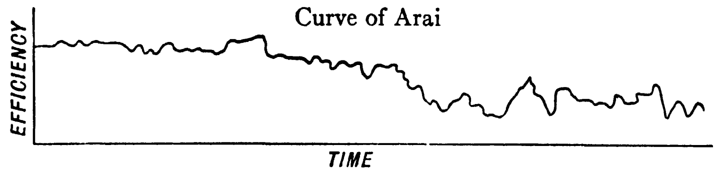
But although to distinguish between the influence of retention and that of fatigue seems easy enough theoretically, yet to do so practically and quantitatively presents no doubt serious difficulties. And towards solving these the Kraepelin school with their followers in France (Binet, Henri), in Italy (Mosso), and elsewhere, has made many important contributions.

On the other hand, their analysis as just set forth has appeared to many subsequent investigators more detailed and complex than the actual observations warranted. It was even called "fanciful". A simpler analysis was substituted, into only two components. The one consisted of the fatigue tending to decrease the output. The other—under some such name as warming-up—included all the influences by which the output was, on the contrary, increased.

Representative of this more sceptical standpoint have been above all others Thorndike and his school, as exemplified in the following curve supplied by Arai. The work consisted in the mental multiplication of one four-place number by another. It heroically lasted for twelve hours. An interesting sequel has been the work of Ritchie.

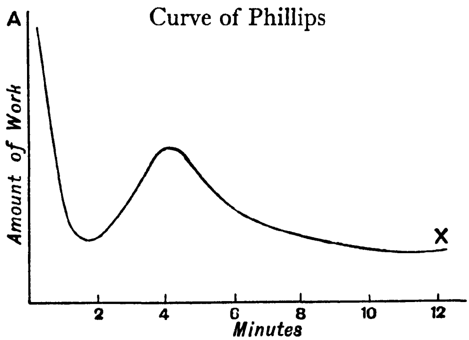
The next great scientific advance arose mainly from taking averages (so as to reduce the disturbances by

accidental variations) and from employing smaller intervals of time. By these means Chapman showed that normally and regularly the curve began with a distinct drop, reading its lowest point in about two minutes. Phillips verified this, and showed that after



another couple of minutes there followed a slight rise and then a further fall. The total curve for the first few minutes thus took the shape marked in the following figures from A to X.

But this rather complex curve, Phillips showed, can be regarded as the sum of the two simple component curves, the one representing deterioration of the output



by fatigue, the other and less steep component indicating the simultaneous improvement by warming-up.

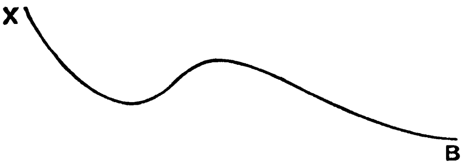
§ 3. *Effect of Rest*

So far, however, we have regarded only one side of the picture; that is to say, how any capacity to work is altered by continuing to work. There is, then, still to

consider how far and in what manner the capacity is further changed by introducing more or less prolonged periods of rest.

The effect of such pauses had already, and very naturally, attracted the investigation of the Kraepelin school, but with results disappointingly indefinite.

More fundamental would appear to have been in this respect the research of Phillips. By means of ingenious experimentation and inference, he arrived at what he designated as a curve of recovery. This is represented in the accompanying figure from X to B.



It presents a remarkable similarity to the work curve given above. Both curves descend very rapidly at first to a minimum, and then rise to a turning point which is considerably lower than the start. In both cases, the complex curve can be resolved into two simple ones. But in general the curve of recovery is much more spread out in time than is that of the original work. Accordingly, whilst the effect of one minute of work was eliminated by four minutes of rest, that of four minutes of work failed to be eliminated by sixteen minutes of rest, while that of twelve minutes of work seemed to require for complete elimination a very long rest indeed.

From these results an important distinction may be made between the fatigue that is manifest and that which is latent. At the end of the first four minutes or so, the work curve has fallen considerably, but shows very little further tendency to fall. Thus, if judged by manifest appearance, fatigue has almost come to a standstill. But if, instead, we judge by the time that will be needed to restore the original full working capacity, then we must infer that fatigue has been markedly increasing all the time and that the greater part of it had previously lain

hidden. Indeed, something of this sort makes a frequent appearance in ordinary life. For instance, the players at a tennis match do not for a long time manifest any decrease of skill. But if the match is sufficiently protracted they at last begin to do so and take long to recover. Evidently enough some sort of expenditure must in some hidden fashion have really been going on all the time.

§ 4. *Effect of Volition*

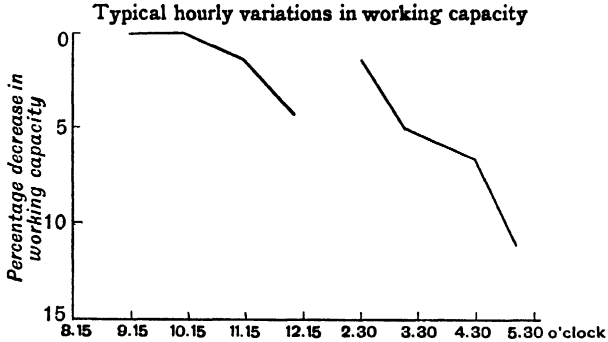
Let us now turn to the knowledge that has been gained about a further influence on work. This is that of the conation considered in the previous chapter. Obviously the amount of work done by anyone at any time depends to a large extent on how hard he is *trying*.

In general the psychologist has sought to suppress irregularity from this cause by keeping the subject's effort at one uniform level: its maximum. But in the case of prolonged work, a particular difficulty arises. The operation becomes more and more unpleasant; it brings boredom, weariness, even bodily pain. Thus, over and above the increasing disability, there supervenes an increasing dissatisfaction. This serves, no doubt, a good biological purpose; it warns us against carrying the fatigue to excess. But it also introduces a very serious disturbance into work curves.

Against this the zealous experimental subject will usually put up a good fight. For the comparatively brief period of an experiment he will endure almost anything. But not so with ordinary people in ordinary life. The schoolboy and the factory hand have to go on working year-in and year-out. They have no reason for disregarding the biological signal. In point of fact, they are almost excessively sensitive to it. Under these conditions, naturally enough, there have been found such work curves as the following, taken from the weaving

industry by Wyatt. (Note that from 12.15 to 2.30 there was a rest.)

These curves are derived from average results compiled from many subjects; the case becomes still more complicated when we consider individuals. Some people give way to the sufferings from fatigue much more readily than others do. Indeed, some appear really to suffer



more than others from this cause. For instance, one person who had spent several hours in continuous mental multiplication showed throughout no deterioration of rate or quality, but nevertheless described her resulting state as follows:

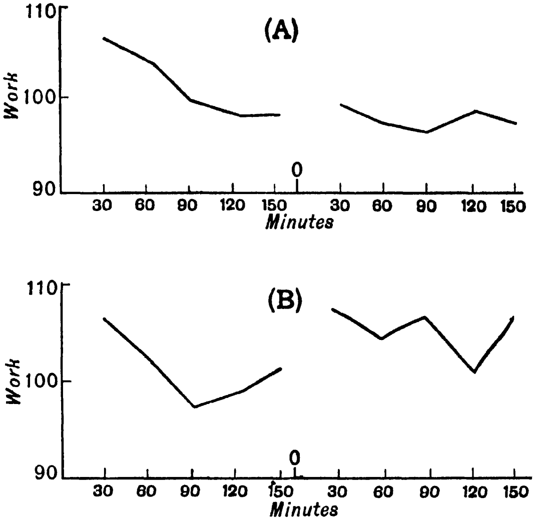
> " After an hour my eyes felt as burning coals of fire, my hands trembled, the back of my head had a ' drawing ' feeling and felt uncomfortably warm. . . . When at 8 P.M. I stopped the ' feelings ' didn't stop. My head continued its ' large as a barrel ' feeling, and in my head and down my spine little hammers kept up a lively tune. Only after a long time did sleep come. Great fatigue was felt the next morning as well."

Conversely, other subjects in the same research were found to show great falling off in actual work, but yet reported little or no suffering from it. In short, as Thorndike remarks:

> " There seems to be little correlation between the fact of fatigue and the feeling of fatigue."

Small wonder, then, that different individuals may show markedly different work curves, even for the same occupation ; and much more so for diverse occupations.

Here are Wyatt's curves for two persons A and B, where in both cases the work consisted in pulling against



a powerful spring balance at half-minute intervals with the left and right hands alternately, there being a rest of one hour for lunch.

§ 5. *Effect of Change*

The effect of rest may be interestingly compared with that of change. Here opinions have sharply diverged. Some people declare that fatigue can only be removed by rest, whilst others maintain that change of occupation is equally effective. The one side is assuming fatigue to be something general, which extends throughout all mental and perhaps even physical ability, whereas the other side takes it to be something specific, which is confined to the particular kind of work from which it arises.

The most penetrating experimental evidence on this point appears once again to have been that of Phillips. And the issue seems to be that each side had got hold of a part-truth. The only reasonable interpretation of the observed facts would seem to be that fatigue is *partially* general and *partially* specific. In so far as it is general, subsequent work of another kind can only aggravate the incapacity. But in so far as it is specific, it affords rest to the earlier kind of activity at the expense of the later kind.

All this about fatigue, be it understood, refers solely to reduction of mental output by sheer disability. It does not include the reduction which many derive from mere distress and consequent disinclination. This latter sort of reduction can often be altogether removed by change; sometimes almost miraculously. Not uncommonly, for instance, it happens that household duties tire a girl seemingly to the point of exhaustion, and yet on changing her activity in the home to that of a dance in society, she becomes quite lively again.

§ 6. *Alleged "Law of Relativity"*

The moment seems to have arrived when we can most opportunely take into consideration a doctrine which has not only been widely asserted but has even—the sole case save that of "association"—been quite commonly accepted as "a great mental law". This is the "law of relativity", which Bain describes as follows:

> "Change of impression is an indispensable condition of our being mentally alive. . . . We can neither feel nor know heat, except in the transition from cold."

In so saying, he seems to be accepting the dictum of Hobbes:

> "To perceive always the same thing is the same as not to perceive at all."

And behind him, again, we may go right back to the relativity of Plato, and even of Heraclitus.

Now this assertion has been interpreted in various manners, which probably the writers themselves often failed to distinguish. For instance, it sometimes seems to indicate that nothing can be known save by comparison with something else. But at other times it would appear to imply that the focus of attention is perpetually and necessarily wandering from one object to another. But actual experiment has shown this statement to be an exaggeration, though not without a core of truth. Billings has proved that attention can indeed stand still, though only for a very brief period. It can be held fixedly upon such a simple object as a dot of ink, a point of pressure, or the noise of a buzzer, for an average duration of about a couple of seconds.

But why not longer? The reason seems to lie once more in our present law. The effect of continued concentration on such simple objects is nothing but an extreme case of specific fatigue. Owing to the minuteness of the objects, no rest from such fatigue can be afforded within the object. Hence exhaustion is speedy, and recourse to another object becomes inevitable (by virtue of the law of constant output).

§ 7. *Case of Catharsis*

Let us turn to another case on which our law of fatigue may be not without bearings. It is that which has been called "catharsis".

This term was employed by Aristotle to denote a purgation of the mind from the dominion of passions, such as anger, pity, fear, and enthusiasm. The treatment consisted in exciting the passion artificially; for instance, by music. After such treatment, he believed, the patient experiences relief and returns to normality.

Akin, possibly, was the treatment which, under the name of "abreaction", became for a time a pillar in the therapy of psycho-analysis. Subconscious harmful emotional complexes were taken to be relieved by being brought up into consciousness.

It would seem, then, that the catharsis involves the rule that a mental tendency is weakened by being carried into effect; otherwise expressed, the occurrence of a process makes its own recurrence more difficult. But this formulation is only that of the law of fatigue again. One wonders how deep the analogy goes. Can we suppose that the experience of any particular emotion uses up some particular psycho-physiological tissue? Is it possible that, as a person gets tired of writing, so also he may get tired of anger, of fear, or grief, or even of love?

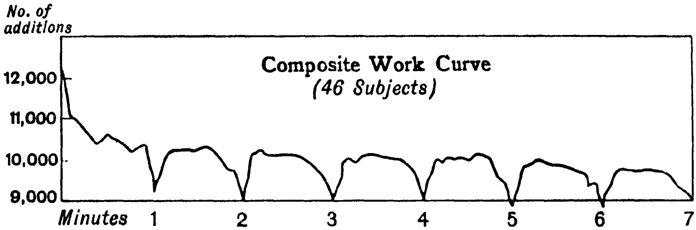
§ 8. *Oscillation*

At this point let us try to make good a previous omission. The components which we have cited so far, both the fatigue and the warming-up, would by themselves result in a curve that is perfectly smooth. Whereas really every individual curve (though not necessarily the average of many curves) is continually fluctuating.

This fact was already obvious to Kraepelin. And to meet it he postulated yet another component of the curve. This consisted of a rapidly oscillating "will-tension" (*Willensspannung*). Subsequently the fluctuations seem to have been dismissed by Thorndike as mere products of "chance". Phillips generally aimed at eliminating them by means of considering averages only.

But a new era arrived when they were submitted to much more penetrating study by Flugel. He and his students found that the oscillations were far from being distributed randomly up and down. Instead, they con-

sistently took the form of valleys separating, not corresponding peaks, but plateaus. These latter seemed to constitute the normal level, whilst the valleys were only lapses from it. Introspection, too, concurred in showing the oscillations to be indications of weakness. The experimental subjects reported about the valleys, that in them the mind often tended to become " void of content ". The will was found quite powerless to overcome them. (See following figure.)



Subsequent investigation, especially by Philpott, disclosed several further facts, the most notable being that their successive durations ran in geometrical rather than in arithmetical series.

On the whole, although possessing some curious features of their own, all these oscillations seem to be further phenomena that fall within the sphere of the law of fatigue, as this is here envisaged.

And in this fashion, it is brought into line with some known mental fluctuations of other kinds. One, already noticed by Hume, consisted in the intermittent character of very faint sensations. He wrote :

> " Put a spot of ink on paper and retire to such a distance that the spot becomes invisible ; you will find that on your return and nearer approach the spot first becomes visible by short intervals, and afterwards becomes always visible."

Other more or less analogous fluctuations were found—especially by the pupils of Wundt—in such other fields as imagery, memory, and reversible perspective.

§ 9. *Explanation of Fatigue*

Throughout we have been considering phenomena which can be explained by the law of fatigue. But how, then, shall we explain this law itself? If, as seems to be the case, it is psychologically fundamental, then to find anything still deeper, we seem almost necessarily referred to something physiological.

Accordingly, the attempts to explain fatigue have been mainly on a physiological basis. They have been founded on the concept of "metabolism", which was suggested by Schwann in 1839 to express the chemical changes undergone by the constituents of the body from the time when they are taken in as food to when they are finally excreted.

Such metabolic processes have generally been divided into two fundamentally different kinds, a view greatly developed by Hering. On the one hand, there are the "anabolic" or "assimilative" processes by which the bodily cells are built up. On the other hand, there are the "catabolic" or "dissimilative" ones by which the cells are broken down again. And most physiologists—in opposition to Hering—have taken the phenomena of life, such as work, to derive from the dissimilation. Furthermore Hermann, in 1867, advanced the view that, in the case of muscular work at any rate, these dissimilative processes themselves are of two sorts. One is the contraction process, which expends energy and is associated with the production of carbon dioxide, lactic acid, and myosin. The other process is associated with a using up of the tissue itself, thus giving rise to carbon dioxide and creatine.

Here, seemingly, is just what we want. The using up of the particular tissue subserving a particular kind of mental work fits in excellently with the "specific" fatigue. And on the other hand, the pouring of such poisonous

substances as lactic acid into the blood, and therefore the distributing of it throughout the body, would appear to account for the kind of fatigue that is "general".

Unfortunately, the case becomes much less clear when we turn, as we must, from the fatigue of muscles to that of nerves. For in the latter case the oxidation has been found by A. V. Hill to be extremely minute, so that the ensuing intoxication of the blood must be correspondingly minimal.

In this quandary, some assistance may possibly be afforded by the "mass action" which we have encountered already. For if mental work involves both the specific action of a small brain area and also the mass action of a relatively large area, then the situation seems clear enough. The specific kind of action naturally leads to specific fatigue. Similarly, the mass action must needs engender fatigue that is no less general. It must produce an effect that may be regarded as a diminution of the whole available energy. Why the work should oscillate remains, truly enough, far from obvious. But at least it is as compatible with the theory of energy quite as much as with any other theory.

§ 10. *Application of the Law*

With or without satisfactory explanation, physiological or otherwise, the establishment of the law of fatigue would certainly appear conducive to foresight, and this too in matters of great practical importance in everyday life.

Thus a knowledge of the operation of specific fatigue supplies a warning of the futility and even danger of too long uninterrupted hard study of one and the same problem. Again, it explains much of what is known as the wandering of attention and readily suggests remedies.

Further knowledge about general fatigue shows just how much good can and cannot be done by change of activity instead of its cessation.

Yet again, knowledge of the course of recovery from fatigue is invaluable for the purpose of arranging a scheme of work and rest. In particular, the rapid recovery during the first three or four minutes of repose and the slower recovery afterwards have indicated the previously unsuspected value of short rests as compared with long ones.

Once more, few facts are more important in education than a knowledge of how far and under what conditions the continuance of hard work is under the influence of volition, both conscious and unconscious.

Even more momentous is similar knowledge applied to the work of industry; notably by Myers and his staff.

But such illustrations might be indefinitely multiplied.

§ 11. *Upshot*

The main result of the present chapter is that the study of fatigue, far from not belonging to the domain of psychology, is among its greatest conquests. It supplies a law that in large measure satisfies both requirements of science: foresight and fundamentality. It displays one of the most definite advances made by psychology over common sense. Yet, strangely enough, psychological text-books usually pass it by with little or no mention.

CHAPTER XXXIV

LAWS OF "NOEGENESIS"

§ 1. Need for Other Laws. § 2. Unfavourable Reign of Faculties. § 3. "Sensation" Again. § 4. Law of Experience. § 5. Law of Relations. § 6. Law of Correlates. § 7. Growth of Knowledge. § 8. Degeneration. § 9. Matter and Manner. § 10. Yet Further Laws? § 11. Scepticism and Dogmatism. § 12. Upshot.

§ 1. *Need for Other Laws*

Again we may ask about these laws—Are there any more of them? And even if no others have been explicitly formulated as such, there might still conceivably be further relevant facts over and above all taken into account already.

Taking this last possibility first, we can safely say that this, at any rate, is actually realized. Clearly, all the four preceding ultimate laws of retentivity, control, output, and fatigue (that of association is not ultimate) treat solely of degree. They only state how mental processes may undergo increase or decrease of quantity. They fail to indicate what these processes are.

For example, suppose that a person hears some music. He will understand it more fully and more quickly when he tries to do so (control); when he is not preoccupied with other things (output); when he has heard it before (retentivity); when he is not tired (fatigue). All four influences, then, do determine how well he understands the music; but they give, it would seem, not the slightest hint as to what sort of operation this understanding is.

After all, then, our four laws are merely subsidiary. Little it boots to determine "how much", unless we indicate "of what". Quantity can only be isolated from quality as a device for convenience of exposition.

This all-important attribute, quality, seems to fall into two divisions, belonging respectively to cognition and orexis. Let us take the former first and look for laws which account for the quality of the knowledge generated. Above all things we want to be able to pick out a complete set of them. This is the hardest and most vital of achievements. An incomplete set of laws leaves the event which is at issue incompletely determined and therefore not amenable to prediction. We are as helpless with it as we are in algebra with n variables and less than n equations.

§ 2. *Unfavourable Reign of Faculties*

The problem of finding laws that govern the origin of cognition certainly goes back to the most ancient psychological history. But during all the centuries anterior to the Renaissance (and to a large extent even afterwards) the whole of psychology was dominated by the concept of "faculties". And these, however helpful towards the ends for which they were introduced, were but ill-adapted to the study of conformity to scientific law. In the course of their exposition, no doubt, a large number of the facts that were mentioned offered more or less prospect of being embodied in laws eventually. But there was in the ancient way of thinking not much scope for carrying this embodiment into execution.

Consider the first of the two great cognitive faculties, that of sensory perception. In it, Aristotle tells us, a person is moved by and suffers from an external object. In so doing, he adds, the faculty is receptive of the forms

of things sensible without their matter, as wax receives the impress of the seal without the gold of which the seal is composed. During the process of perception, he tells us, the faculty is not similar to its object, but after the impression it becomes so.

Now in respect of the generality needed for laws, all this leaves little to be desired. But as regards the definiteness also required—especially for the purposes of prediction, so as to enable the teacher, the physician, or the industrialist to measure and foresee psychic growth and disturbance—in this regard the statement made by Aristotle that perception is like the impress of a seal appears to be unhelpful.

Nor does there seem to be any great improvement when we go on to the other great cognitive faculty, that of reason or thought, as expounded by Aristotle. Like sensory perception, it is receptive of the form of objects. But, unlike the perception, which only presents objects of a certain class, thought comprehends all things whatsoever. It does this "in order that 'to use the phrase of Anaxagoras' it may rule the world". "Its very nature, then, is nothing but just this comprehensive potentiality." How to turn all this to the practical purpose of foresight is surely hard to see.

§ 3. "*Sensation*" *Again*

To get away from all these faculties to other psychological viewpoints more serviceable for our present purpose, we must push on to the Renaissance, and especially to Locke. The latter asked, as we are doing, Of what kind of material is mental life made? For him, as for us, any association of "ideas" cannot be more than a secondary event; before ever being associated, they must first be generated.

One great source from which he supposed them to

originally issue consists in what he designated as Sensation :

> " Our senses, conversant about particular sensible objects, do convey into the mind what produces there several distinct perceptions of things, according to those various ways wherein those objects do affect them : and thus we come by those ideas we have of yellow, white, heat, cold, soft, hard, bitter, sweet, and all those which we call sensible qualities."

In this passage we are certainly getting nearer to what we seek. Indeed, at first sight, it would seem to have all the definiteness that is needful. But so soon as this concept of " sensation " is submitted to finer analysis and more searching criticism, then unexpected troubles arise (see Chapter XII). In particular, some difficulty may be found in harmonizing it with Locke's other great fountain of ideas. To this we will now turn.

§ 4. *Law of Experience*

Locke, following Gassendi in not being content with sensation alone as supplying ideas, added thereto a second source of them, namely, " reflection " :

> " The other fountain, from which experience furnisheth the understanding with ideas, is the perception of the operations of our own mind within us, as it is employed about the ideas it has got ; which operations, when the soul comes to reflect on, and consider, do furnish the understanding with another set of ideas, which could not be had from things without ; and such are, perception, thinking, doubting, believing, reasoning, knowing, willing, and all the different actings of our own minds. . . . This source of ideas, might properly enough be called internal sense."

In these words—when rightly understood—that self-acquaintance which had only given to Plato and Aris-

totle occasion for incidental remarks, and which even with Plotinus had revealed more metaphysical than psychological interest, does seem to have approached at last the status of a scientific mental law. As regards the requirement of sufficient precision to foresee the future and retrace the past, no more striking instance appears to be needful than the one brought forward by Locke himself. This is the use he makes of it for the purpose of discovering the genesis of such ideas as those of "power". As regards the requirement of wide scope, the fulfilment of this too could hardly be more obvious and complete. So also, as regards the requirement of ultimacy. For no one would appear to have even suggested any resolving of this law into anything more fundamental. Nor, finally, is much amiss with the law even as regards the final and less indispensable requirement of being rational. Even the man in the street appears to realize that if anything is ever to be known at all, it is surely what one consciously does oneself. This doing appears to him to be self-evident; in other words, to be directly known by "intuition", or "insight". And the profoundest philosopher seems to fare not otherwise. When Augustine, Occam, Campanella, and Descartes despairingly looked around for any sort or description of ultimate unquestionable truth, upon which to build up knowledge even of their own existence, did they not all take refuge in assuming awareness of their own activity? Descartes said: I think, therefore I am. (*Cogito, ergo sum.*) Augustine, more strongly still: "Even if I err, I am" (*Quod si fallor, sum*).

Altogether Locke with his "internal sense" would appear to take us a long way. What contributions have been added by his successors? They seem to have treated this matter in much the same fashion as so many others. Time and again, they have claimed to simplify psychology by eliminating something; and then later

they have claimed to enrich the science by now discovering it. Among prominent explicit advocates of some such internal or inner sense have been Leibniz, Wolff, Tetens, Laromiguière, Herbart, and Wundt. Much more numerous, however, are those in whose writings the theorem is not expressed outright but only implied (see Chapter XXI).

To close this brief account of the so-called internal sense, we must concede that it has some serious difficulties. Locke, himself, as Aristotle before him and many others afterwards, appears to have assumed that a person's awareness of his own mental operations is something *a priori* necessary; a virtue inherent in the very notion of mind, and no more to be divorced from it than a concave curve is from a convex one. But according to Plotinus and another section of psychologists, the awareness of one's mental operations is not necessary but only contingent; it may indeed occur, but also it may not.

Again there is the great problem as to what is its original linkage to Locke's other source of ideas, "sensation". *One* answer to these questions has been supplied in our Chapter XII. According to this—and perhaps not far from the view of Locke himself—sensory cognition must be supposed to begin with, or soon turn into, that of the four fundamental sensory attributes. And these, or something allied to them, are believed to be primarily experienced as states, felt but not known. But eventually from these states there emerges knowledge. This primeval "booming, buzzing confusion" is converted into objects of cognition. It becomes "ideas" in the broad Lockian meaning of the word. If this view be accepted, then after all Locke's two ultimate sources of knowledge fuse into one. Even those ideas which he would attribute to "sensation" would derive really from one's awareness of one's own states.

Waiving for the present this and other difficulties that are important but not vital, we seem justified in formulating the following law, at any rate provisionally:

> *A person tends to know himself and items of his own experience.*

This process is represented in Diagram I, p. 130, where the drawn-out rectangle stands for the person's experience, whereas the dotted rectangle stands for what he knows of it.

§ 5. *Law of Relations*

However, although Locke ostensibly reduces the origin of ideas to the two sole sources, external and internal sense, he would appear to introduce really much more. For in addition to these two he postulates a third source, namely, comparison. And this he explicitly represents as bringing in an entirely new class of ideas, namely, what he calls those of relation.

Going far beyond his predecessors, he states that

> " the comparing (of qualities) with one another, in respect of extent, degrees, time, place, or any other circumstances, is . . . that upon which depends all that *large tribe of ideas* comprehended under relations ; which of how vast an extent it is, I shall have occasion to consider hereafter."

To this knowing of relations, it will be remembered, we devoted the greater part of Chapter XIII, noting in particular that it includes the case of perceiving " form ", and that it plays a dominant part in the cognitive operations of common sense.

Nevertheless it shows itself to have been extraordinarily neglected by the leading psychologists. One reason for such failure, probably, was Locke's unnecessary and paralysing limitation of the perception of relations to that which is produced by acts of

"comparison". But even after Brown had, two hundred years later, so expressly and emphatically repudiated this limitation, the part played by relations in mental life has still almost everywhere been strangely ignored. Incidentally, the psychologist, like everyone else, does and must talk of them every moment. But in his scientific exposition they are only conspicuous by their absence. Worse than all, the two modern psychologists, Spencer and Bain, who did realize adequately the importance of perceiving relations, broke down, each in his way, on a catastrophic fallacy about them (see p. 236).

In such default of assistance from elsewhere, we will here proceed to set forth the view of relational cognition that has been specially developed by the so-called London school. In this formulation, the law runs as follows:

> *On the presentation of two or more items, a person tends to know relations between them.*

This process is represented in Diagram II, p. 130, where f_1 and f_2 stand for the two items presented, whilst r is the relation known between them.

In order to render this law psychologically alive and fruitful, however, it must be supported by an enumeration and description of all the known relations. As to what precisely these are, there is naturally room for difference of opinion. But there has not been much controversy; for the simple reason that there has not been much consideration. The following is one attempted list:

> Evidence, Likeness, Conjunction, Space, Time, Psychological Objectivity, Identity, Attribution, Causation, and especially *Constitution*.

Some illustrations in the sphere of sensory perception have been given in Chapter XIII. More complete—

though still simple—are the illustrations drawn by Wynn Jones from various mental tests. Immediately included under it are all genuine cases of "judgment" (see Chapter XVI).

Now, this law does seem to satisfy the cardinal requirement of being precise enough to afford provision and retrovision. Its application to mental tests is proof enough of this, at any rate. As for the extent of its scope, this too would appear to be all that can be desired. The requirement of ultimacy would also seem to be satisfied. True enough, there are some apparent exceptions, but these can easily be explained. As for the last requirement—the one which is almost a luxury—that of being rational, even this appears to be met as well as can be expected. To take the classical instance, if anybody perceives two white surfaces as such, this experience seems to be a perfectly good reason for perceiving them to have the relation of likeness. Otherwise expressed, the law of relations, no less than that of experience, is firmly based on self-evidence or "insight".

§ 6. *Law of Correlates*

Wide as are the nets spread out in the two preceding laws to gather in the origins of ideas, they do not yet catch everything. Indeed, the number of further mental operations allegedly productive of ideas is very large.

A prominent instance has been already encountered by us (Chapter XIV), under the title of "Adjusted Supplements"; it was made chiefly responsible for the fact that normally the stimulation of our sense organ produces, not subjective "sensations", but rather objective things.

For glimmerings of the principle, we have, as usual, to go back very far. The Epicureans were occupied with the problem and, under guidance of their general

mechanical viewpoint, arrived at conclusions which have been summarized as follows:

> "Every notion proceeds from the senses, either directly, or in consequence of some analogy, or proportion, or combination."

Much more complex were the results said to have been reached about the same time by the Stoics. So interesting is the exposition of these results that we will take the liberty of quoting it at some length:

> "All our thoughts are formed either by direct perception, or by similarity, or analogy, or transposition, or combination, or opposition. By a direct perception, we perceive those things which are the objects of sense; by similarity, those which start from some point present to our senses; as, for instance, we form an idea of Socrates from his likeness. We draw our conclusions by analogy, adopting either an increased idea of the thing, as of Tityus, or the Cyclops; or a diminished idea, as of a pigmy. So, too, the idea of the centre of the world was one derived by analogy from what we perceived to be the case of the smaller spheres. We use transposition when we fancy eyes in a man's breast; combination, when we take in the idea of a Centaur; opposition, when we turn our thoughts to death. Some ideas we also derive from comparison, for instance, from a comparison of words and places."

Passing over the next twenty centuries—without much missing them—we come upon the interesting concession of Hume that, if a person had somehow become acquainted with every shade of blue save a single intermediate one, he would from his own imagination be able to supply the deficiency. This case, however, he then curiously dismisses as being too exceptional for further notice.

Soon afterwards, we come upon the following very suggestive passage of Hartley on the use of "analogy":

> "Analogy will lead him (the inventor) by degrees, in works of fancy, from the beauties of celebrated masters to

others less and less resembling these, till at last he arrives at such as bear no visible resemblance. Deviations and the subordinate analogies contained within them will do this in a much greater degree; and all analogies will instruct him how to model properly such entirely new thoughts, as his memory and acquaintance with things have suggested to him. In science analogy leads on perpetually to new propositions, and, being itself some presumption of truth, is a guide much preferable to mere imagination."

In quite modern times we encounter, though rarely, such allied and valuable references to the formation of ideas by analogy as those of Stout, Hobhouse, Carveth Reed, and K. Bühler.

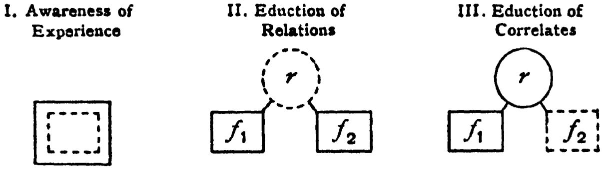
Now, the employment of "analogy" in thinking, arguing, or discoursing has commonly been taken to indicate vaguely enough almost any kind of similitude. But in the operations thus covered by the term there may be discovered by finer analysis one very definite and unique process, which has been called the *educing of correlates*. In this, combined with the aforesaid educing of relations and the awareness of experience, is said to have been at last discovered the urgently needed *complete set* of laws of original cognition. This third law runs as follows:

On the presentation of an item, together with a relation, a person tends to conceive the correlative item.

This process is symbolized in the following Diagram III (p. 130), where f_1 stands for the original item and r for the relation, whereas f_2 is the conceived correlative item.

In these figures as mentioned the circles represent relations, whereas the rectangles are any items, relations or not. The drawn-out lines show what is given at the beginning of the process. The dotted lines indicate what the process additionally generates. In a stock illustration,

f_1 and f_2 stand for two tones, C and G respectively, whilst r is the interval of a musical fifth. The process represented in Diagram II may be elicited in a person by sounding C followed by G and then asking him what the



interval is. The process of Diagram III may be brought about by finding a person who understands what is meant by a fifth, then playing to him any tone whatever, and finally asking him to sing the tone which is a fifth higher. Note that here, as in all other cases, some individuals can do what is wanted, but others cannot.

As another instance from sensory perception, f_1 and f_2 may stand for the accompanying figures, and r for the complex relation of upside-down-and-half-size. Here, to elicit the process symbolized in Diagram II, the subject may be shown the two triangles and asked to notice their mutual relations. To get the process indicated by Diagram III he may be given only the large triangle and be asked to draw a figure of similar shape, but upside down and half as high.

As an example from the region of thought, f_1 and f_2 may be the ideas of "clumsy" and "skilful", whilst r is the relation of oppositeness. For Diagram III the subject may be asked what is the opposite to "clumsy". Possibly he will go wrong and say "careful".

Owing to the great similarity and intimate connection between the two processes symbolized in Diagrams II and III, there is great need of a common name for them. And so far there seems to be no better resource than to resuscitate the old word "eduction". For a wealth of

examples of all such processes, reference may be made to various researches and publications of W. Line.

Now the preceding three laws evidently have much in common. Accordingly, it is needful to find for them a common name. And for this purpose nothing better could be found than "noegenesis". It is a long word, but holds a great deal. An explanation of it will follow on p. 142.

§ 7. *Growth of Knowledge*

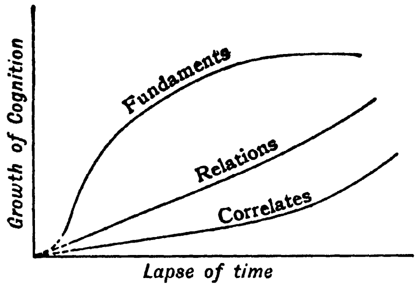
As was only to be expected, and indeed proper, the preceding revolutionary triplet of laws did not fail to meet with opposition. And the most strongly pressed attack upon them has been that they are not really three principles but only one. The distinction between them is said to be not psychological but only "logical". They are declared to be summed up in the single statement, that the mind possesses "relating activity" (Wyatt, Collins).

But those who support the laws hold, on the contrary, that just this specifying of the three different kinds of activity constitutes their cardinal value. For just this it is, they say, which renders them definite enough for their essential purpose of prediction. And moreover, it is claimed, just this division into three, far from being merely "logical" (whatever the critics may mean thereby), is also of the utmost significance for mental function.

To study the multitude both of likenesses and of differences between the three processes, special reference may be made to the research of Mercer (under the direction of Aveling, Chapter XXXI).

For an outstanding instance of their functional differences, we may turn to the all-important case of mental genesis. In general (though not necessarily in detail) the three laws represent so many different stages of

growth. Turning to our diagrams again, No. III postulates an already existent knowledge of both fundaments and relations. The relations in their turn can only have been obtained by previous usage of No. II; but even this assumes the knowledge of fundaments; and these, in last resource, can only have been got by means of No. I. Along these lines the very earliest knowledge would begin by the organism arriving at some awareness of the nature of its own states (see p. 207). On this primordial knowledge of fundaments there supervenes that of relations.



Quite possibly, indeed, the two, knowledge of fundaments and that of relations, begin together. But their courses at any rate soon separate. All child-study indicates that the knowledge of relations becomes with time more and more dominant. This fact has been represented in the figure above, where the dotted lines indicate that this part of the curve is very speculative.

So soon as in this way a sufficient supply of fundaments and especially relations has been obtained, that of correlates proceeds to develop and accumulate.

As a further example of the widely different functions of the three laws, we may note that only the second and third, not the first, are crucial in the current tests of "intelligence". Moreover, in the construction of these tests, the choice between the second and the third function may be a matter of great importance. Again only the third, not either the first or the second, is cardinal in the mental activities frequently entitled creative. In short, the division of the mental activity into the three kinds, far from having only "logical" significance, supplies the

very basis of an effective study of function.

To complete the picture, we have to decide a question that has been intensely controversial. According to the doctrine imputed to the associationists, mental development proceeds by way of aggregating elements into wholes. Whereas, according to the Gestaltists, its procedure is to differentiate wholes into parts. Which of these two general directions, aggregation or differentiation, is advocated in the noegenetic doctrine? On this point there has been much misrepresentation. The true answer is: *Both.* As already indicated, the commencement appears to be with complexes of moderate size. These then are differentiated down into finer and finer detail, and also aggregated up into larger and larger complexes. This applies to all three noegenetic processes. The differentiating is like the lifting of a fog, whereby the spectator sees more and more clearly items "as" related to one another. The aggregating development, on the other hand, resembles more the course of a survey, which first detects the related items and then notices *that* they are related (see further, pp. 162 ff.).

§ 8. *Degeneration*

More subtle than the separating of the "noegenetic" or "eductive" activities from one another is the fixing of their boundaries from those which are merely reproductive. That this delimitation is at any rate not obvious may be inferred from the fact that, from the earliest times right up to this day, few if any psychologists have so much as noticed it. Even now, after it has been emphatically advocated, many authorities still withhold their assent. Some, like the associationists of old, would fain regard *all* cognitive process except sensation as being essentially reproductive. Whereas others, as Hollingworth, would go so far as to deny that *any* cognition

consists in mere reproduction; mental process, these say, never repeats itself, but is ever changing. Yet others, as Philpott, whilst apparently conceding that eduction and reproduction are somehow different, remain still questioning whether the two are really distinct events and not merely two aspects of one and the same event.

To demonstrate the real state of affairs, suppose that a person starts with the ideas of "good" and "opposite", and then for the first time passes from these two ideas to that of "bad". The process is a typical case of the law of correlate eduction; reproduction is not essentially involved. But next, suppose that the passage from "good" and "opposite" to "bad" is very often repeated and so becomes more and more facilitated by the law of retentivity; finally, eduction wholly gives place to reproduction.

How do the two extreme processes, initial and final, eductive and reproductive, really differ? Certainly the final process cannot contain anything additional; for by very assumption it is purely reproductive. But no less certainly it may suffer from omissions. Above all things the fundamental characteristic of eduction, namely, self-evidence, may become weaker and weaker, until at the limit the passage to the idea of "bad" degenerates into a blind habit; the event is, so to speak, mechanized. But this is not all, the process undergoes further alteration; in particular, there is a tendency for some items to drop out altogether. Thus, in our example, it might easily happen that after many repetitions the bare idea of "good" would suffice to arouse that of "bad", the relation of oppositeness having become dispensable. Another change that commonly accompanies the mechanization is a gain of speed. So long as the self-evidence is preserved, the rate at which the process occurs appears—unexpectedly enough—to remain constant (some experimental testimony to this

effect has been already quoted from Menon). But if, on the contrary, the self-evidence is permitted to lapse, then the speed of reproduction may increase to any degree. A common instance of great rapidity is when the sound of a familiar word instantly reproduces its meaning.

All the above quoted degenerative changes are thus found to occur even in such simple events as the evoking of the idea of "bad". Incomparably more striking and diversified alterations ensue in cases of greater complexity, involving as they do such phenomena as "condensation", "regression", "contamination", "rationalization", and so forth (see Memory, Chapter XVI).

So much for the two *extreme stages*; the productive one governed by the law of eduction, and the reproductive one governed by that of retentivity. Each, we have seen, has its own process characteristically different from the other. More commonly, however, we encounter the *intermediate stage*, where the two laws, although still wholly distinct in themselves, nevertheless co-operate in one and the same process. Then the reproductive tendency, though not present purely and alone, will nevertheless exert some influence. And so the whole process acquires the described characteristics—loss of insight, gain of speed, and so forth—in at any rate some degree.

The inference is momentous; to know when the advantages of insight should and when they should not be sacrificed in favour of those of habit becomes vital; for instance, in education. As a brilliant example, there is perhaps nothing to equal the teaching of arithmetic by Ballard. His little books, which are chiefly characterized by demanding insightful eduction and blind habit just where these two are respectively appropriate, have quickly reached the fabulous sale of several millions—not to mention that they have brought to countless despairing school children their mathematical salvation.

After so much consideration of the intermingling of the influence of the two kinds of eduction with that of retentivity, we must dismiss the other quantitative laws with a summary indication that their cases are very similar. They also do not in general have any separate processes, but instead co-operate intimately both with eduction and with one another. Strictly speaking, the laws of the theory do not immediately apply to any concrete processes at all, but instead to tendencies or influences manifested in the processes and only separable from these by an effort of abstraction. This limitation of mental law, however, need scarcely surprise us, seeing that it holds no less for the most fundamental laws of physics (see Chapter XXVII).

§ 9. *Matter and Manner*

How does all this development of the laws of cognition fit in with the separation previously made between the objective matter regarded and the subjective manner of regarding it? The answer appears to be that the laws deal in general with the matter, not with the manner.

On this account, there has in these laws been no reference whatever, explicit or implicit, to the current but treacherous concept of "unity", or even to that of "wholes" and "wholeness-qualities". The insightful knowledge of experiences, of relations, and of correlates is never touched—in principle, at any rate—by the grouping so well illustrated by Schumann and so highly rated by the Gestalt school. They are just as little changed by analysis, so long as this is purely "intentional" (Chapter IV, p. 95), or by "abstraction", so long as this is purely privative (Chapter XVI, p. 270).

But this irrelevance of the laws to the subjective grouping or analysis does not extend—let us reiterate—to Krueger's objective "complexes", "complex-qualities", "forms", "organizations", "structures",

and so forth. On the contrary, it is just in these that the said laws find their most abundant and momentous exemplifications.

Nor, it must be added, are the laws unconcerned with what have been called the "grounds" or "factors" of the grouping or abstraction (Chapter XXIV). For these grounds, in general, are objective. They largely consist in such relations as those of likeness and nearness.

Furthermore, even the subjective occurrences themselves, no less than the objective ones, stand in need of being reduced to laws, albeit from a different viewpoint. Although the arbitrary grouping adds no fact to the objects so grouped, it does add a fact to the mental state of the grouper. And this latter fact itself stands in need of explanation. *Why* do such objective relations as likeness and nearness generate subjective grouping into "wholes"? No answer to this question seems to have been attempted by the Gestaltists themselves. An attempt to fill the gap has been made in Chapter XXIV.

To conclude this Part, we may remark that the complete independence between the subjective and the objective aspects, the manner and the matter of cognition can at most be only an ideal limit. In actual practice, every change in the subjective manner of cognizing will entail wide, if subtle, changes of attention, conation, and so forth, which in their turn will considerably modify the amount and even the kind of objective cognition. A striking example was noted in the case of reversible figures (Chapter XIV).

§ 10. *Yet Further Laws?*

Before terminating this account of the laws of originative cognition, let us see what, if any, further operations have been propounded which might be credited with this office.

Three such, as we have seen, were already suggested by the Stoics. For besides direct Perception and Analogy, they also proposed and even exemplified Similarity, Transposition, Combination, and Opposition (see p. 128). However, every one of these additional processes is at bottom reducible to correlate educing. But *this* is a reduction which the ancients did *not* achieve.

As much can be said of the numerous authors who have revived any of these subsequently. A case in point is that of Locke, when he says that "complex" ideas are formed out of "simple" ones by means of "adding together and uniting" these. Like everyone else, he seems to have overlooked the relation of "constitution".

Somewhat strange is the position of the associationists, who attempt to get away with saying that mental elements become on combination "transformed". As to *what* they are transformed into, and by what means, this these authors omit to mention. Akin is Wundt's celebrated "General Principle of Creative Resultants":

> "The product arising out of any number of elements is more than the bare sum of the elements. It is a '*New Creation*' absolutely incomparable with the factors which co-operated in its structure."

Even here the problem is rather stated than solved. Of what, then, do this surplus and this novelty consist, and how are they achieved?

Another group of alleged mental operations that might conceivably have here come in consideration is implied in the abilities propounded by mental testers and listed in Chapter IX, p. 164. But these, as we saw, were all ephemeral.

Another notable endeavour to formulate the laws of cognition has come from Selz. In his earlier work he attributed all "orderly course of thought" to three laws based on different types of "reproduction". But

this, as we have seen, can always be reduced to the more fundamental laws given above. In the first half of his later work, he divides all simple " intellectual operations " into three kinds: the completion of complexes; reproduction by likeness; and abstraction. But this again, although very interesting in detail, brings nothing new in principle. The first two are essentially the classical forms of associative reproduction (see Chapter XXVIII) and the third is only the classical view of the intellect (Chapter V).

But in the second half of his later work the author proceeds along very different lines. He considers the case where a person is given a mental task which he does not fulfil in any direct manner, but instead complicates by introducing an intermediate step. This case too, however, is only a special instance of the fundamental law of correlates given above.

Greater fame has rewarded the law-making of certain Gestaltists. Pre-eminent here has been the law first stated by Wertheimer, then supported by Koehler and Koffka, under the name of the " Law of Pregnance ", " Law of Precision ", or more ambitiously " Universal Law of Gestalt ". It is formally defined as asserting that mental development starts with " structures ", proceeds by transformation of these, and results in their being " as perfect as the prevailing conditions admit ".

Next most prominent in gestaltist literature would appear to be the law of closure; this does not seem to have been provided with any definition, but it is illustrated by such figures as circles and squares contrasted with such as hooks and spirals. Later on, in 1931, however, Wheeler presented laws in the following array: (1) " Any Mental Process that ' stands up ' under Observation is a Whole "; (2) " Parts derive their Properties from the Whole "; (3) " The Whole conditions the Activities of the Parts "; (4) " Parts emerge from Wholes

by Individuation"; (5) "Wholes evolve as Wholes"; (6) "Law of Least Action"; (7) "Law of Maximum Energy"; (8) "Laws of Configuration".

Four years subsequently, however, this school came to a parting of ways. On the one hand Lewin, in his *Principles of Topological Psychology*, does not specify any law at all. He is absorbed in a hardy effort to base all mental science on the concept of "being included in"; a concept which he endeavours to connect with that rather esoteric branch of mathematics called topology.

With Koffka, on the other hand, in his simultaneously published *Principles of Gestalt Psychology*, the number of indicated laws amounts to no less than twenty-four.

However, to every one of the proposed laws there are grave objections. In the first place, most of them indulge to an unparalleled extent in unverifiable hypotheses; so much so that even McDougall, himself no mean hypothesizer, reproaches them with being "fantastically remote" from actual observation. But much more damaging is the fact that almost all these proposed laws deal with "wholes" and "parts". The evidence about these is almost exclusively derived from subjective grouping; whereas the application of them is fallaciously extended to objective organization, which really runs on fundamentally different lines (Chapter XXIV).

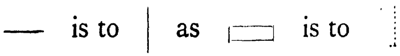
Most fatal of all, however, is that the laws advanced are so indefinite as to fail in the most fundamental of all scientific requirements, that of conferring the power of prediction. True enough such predictive power has occasionally been claimed. But this claim, as indeed the whole edifice of Gestalt-dynamics, has been rudely shaken by McDougall. Their alleged laws can indeed be more or less plausibly fitted on to many facts known beforehand. But this virtue they only owe to that very vagueness and equivocation which render them impotent to predict facts *not* yet known.

To exemplify this fact, let us turn back to the "universal law of Gestalt" cited already (Chapter XXIV), and apply this to the perception of a plain straight line. The law says that the percept will "become as perfect as the prevailing conditions admit". What can really be predicted out of this? In the following figure, which, if any, of the forms given under B can be said to be the "perfection" of the line under A? What, if any, shall be specified as the "prevailing conditions"? The very questions are evidently absurd.

A B

Consider by way of contrast the following case of educing a correlate:

A B C D



From A, B and C, the D *can* be exactly predicted.

§ 11. *Scepticism and Dogmatism*

Before closing this chapter, at least a furtive glance may be taken at its bearings on one of the greatest controversies in all ages. It is that which has been fought between "scepticism" and "dogmatism".

The sceptics deny the existence of any criterion of truth. Extreme among them has been Gorgias, who wrote *On what is not, or on Nature* (see Chapter V). Of gentler mood would appear to have been the Empirics, who did at least admit the evidence of their own experience.

The dogmatists, on the other hand, assert that truth is capable of being proved; even the truth of facts that

transcend the sphere of the person's own experience. On the nature of this criterion doctrines widely differ. But often such principles are set up as:

> "Whatever is, is" and "It is impossible for the same thing to be and not to be."

Now, the three laws in this chapter depart altogether from both the one doctrine and the other. Throughout the length and breadth of their domain the processes expressed in them are taken to possess the one and only ultimate criterion of truth, "self-evidence" or "insight". When pure, these processes are infallible. But they never are pure. They always contain more or less error deriving from another law, that of retentivity (Preface). And not the least task of psychology is to sort out the two laws from one another.

To express this character of insight and also that of creativeness, the three processes have received the name of "noegenesis". The *noe-*, from the Greek νοῦς, have been intended to indicate that these processes, and these alone, have the virtue of self-evidence. The *-genesis* implies that these same three processes, and no others, generate novel items of knowledge.

It should, however, be noted that in proportion as any of the processes undergo the above described mechanization, they lose both these characteristics of self-evidence and creativeness. From "noegenetic" they degenerate into "anoegenetic".

§ 12. *Upshot*

This chapter has been chiefly devoted to considering a very ambitious adventure. Under the name of "noegenesis", the claim has been made to formulate a complete set of laws expressing and explaining the origin and the evidence of all knowledge.

The first of these laws is to the effect that a person tends to know himself and items of his own experience. This is universally implied in common speech. Indeed the fact is too obvious to be explicitly repudiated even by psychologists, save extreme doctrinaires. But none the less, the great majority of them have given to it little, if any, notice.

The second claimant to the rank of law, namely, that a person tends to perceive relations, is so extraordinarily manifest that no psychologists at all have had the courage to deny it explicitly. Nevertheless there has been almost as little actual consideration vouchsafed by them to it as to the first law.

The third claimant is that, given a fundament and a relation, a person has a tendency to conceive the correlative fundament. This fact, far from being obvious like the other two, has throughout history almost everywhere escaped any notice at all, not to say clear analysis.

However, the real essence and novelty of the theory does not consist in discovering any brand-new processes of knowing, nor even in investing any known process with previously unsuspected importance. The new aim has been, rather, to reduce all possible insightful processes to the operation of a small but *complete set* of them, which may be regarded as fundamental laws.

We have in the course of the present chapter considered how far three such laws have been shown, in the first place to be true to fact, and in the second place to possess the characteristics required by predictive science (width of scope, definiteness of formulation and essential rationality). Furthermore, we have indicated the momentous co-operation of all this insightful cognition with that which is merely blind habit. Finally, we have considered the other leading claimants to constitute fundamental laws of knowing.

CHAPTER XXXV

ALLEGED LAWS OF "OREXIS"

§ 1. Associationism Again. § 2. Modern "Law of Organization". § 3. Ancient Orectic Logic. § 4. Psycho-analytic "Mechanisms". § 5. Law of Impulses. § 6. Law of Will. § 7. Secondary Laws. § 8. Upshot.

§ 1. *Associationism Again*

In the preceding chapter, we gave an account of the attempts that have been made to establish laws governing the creation of knowledge. Here we have to consider the still hardier enterprise which deals similarly with the creation of orexis; which would discover laws that govern such elusive, almost sacrosanct, things as the emotions and especially the will. Whereas in Chapter XXXI we searched for laws governing the effects of volition, we have now to look for those which govern its causes. To common sense, the very quest seems folly.

There is, then, small ground for surprise when we find such a task to have been seldom undertaken by psychologists until comparatively recent times. As already mentioned, the great inspiration to regard events from the viewpoint of laws came from the physics of Newton and was carried over into psychological science by Hartley.

In his eyes, however, all orectic experiences consisted exclusively in the "passions of love and hatred" which "arise from pleasure and pain". And these passions, as all others, he declared "can be no more than aggregates of simple ideas united by association".

For him and his school, accordingly, the orectic experiences no less than the cognitive ones do fall within the reign of law. And precisely the same law—that of association.

The scientific prospect thus opened out is dazzling enough. The whole vast territory of mental experience—orectic no less than cognitive—is submitted to one single law, all-inclusive, perfectly definite and irreproachably quantitative!

Unfortunately all these excellencies put together are of little account unless they happen to be attended by yet another one; that of conformity to fact. Granting that upon such a bare associative basis there can indeed be built up a grandiose psychology, we still have to inquire whether this will then be the truth, the whole truth, and nothing but the truth. And in this decisive respect our story has already had to chronicle a cataclysmic failure. By an overwhelming majority of modern psychologists, the doctrine of associationism has been impeached, and, it would seem, convicted, of utter inadequacy.

§ 2. *Modern "Law of Organization"*

This collapse of the associative law, its inability to cover the greater part of the facts—or even the most vital of these—brought the associationists into a delicate situation. But not one that some of them could not handle. Since the facts could not be brought within the pale of association, they expanded association so as to take in the facts. That which proved to be the very opposite to anything reasonably called "associative" they nevertheless proceeded to entitle the law of "systematic" association.

Despite this play with words, however, some of the leading writers cannot be accused of mincing the facts

themselves. Paulhan himself contrasts this superadded law with that of mere association in terms of exemplary vigour. He depicts the new-comer as

> " that great universal law which makes everything that develops pass from plurality to unity, from incoherence to system, from chance to finality."

In the same year, much the same trend of doctrine cropped up in the work of Dilthey, which has since been very influential on such German authors as Spranger. But by these authors, as we have seen (Chapter XX, p. 347), the curious attempt was made to depict the two kinds of process, associative and systematic, not as mutual supplements but as alternative viewpoints. The study of the associations is assigned to " explaining " psychology; that of the systematic connections to " descriptive " psychology (see p. 361).

With Ribot, subsequently to Paulhan, the said " great universal Law " became defined as involving

> " a process whose whole course is affective; that is to say, consists in a state of feeling (sentiment), which, whilst remaining identical or being transformed, determines the choice and the enchainment of intellectual states."

In contrast, he declares that association, even on an emotional basis,

> " is very different; it develops by chance, without being directed towards a pre-determined goal."

At the present day, by far the greatest elaboration of this law of organization would seem to be that of Shand, who formulates it as follows:

> " Mental activity tends, at first unconsciously, afterwards consciously, to produce and to sustain system and organization. . . . This seems to be the fundamental law underlying all other laws of character."

The product of such organization is named by him a

"sentiment", and under this title has been warmly accepted and acutely studied by McDougall.

§ 3. *Ancient Orectic Logic*

After this fashion, there has been a strong movement in recent orectic psychology to supplement the law of "association" by another one of "organization". Can we credit this movement with being original? Our answer may perhaps be a qualified affirmative, if we only take into consideration the last few hundred years. But very different must be the verdict, as already shown (Chapters X and XX), if we go back further still. Take, for example, the first of Shand's sub-laws, by which his "fundamental" law is expanded and further determined:

> "Every primary impulse, whether it is independent or belongs to a primary emotion, is innately connected with the systems of fear, anger, joy, and sorrow, in such a way that, when opposed, it tends to arouse anger; when satisfied, joy; when frustrated, sorrow; and when it anticipates frustration, fear; these systems being similarly connected together."

This plainly belongs to what in Chapter XX was called the "logic of emotion" and had to be mainly credited to such a venerable author as Aquinas. Or, take Shand's third sub-law:

> "In the growth of character, the sentiments tend with increasing success to control the emotions and impulses; in the decline of character the emotions and impulses tend with increasing power to achieve their freedom."

This evidently deals with the same theme as what in Chapter XX was called the integration of Character by Principles.

Evidently, then, the main facts have been well known since very ancient days. The sole novelty would

seem to consist in formulating these facts as a scientific law. This might perhaps be enunciated as follows:

> "*Any orectic attitude towards any object tends to induce auxiliary attitudes towards other objects.*"

Implicitly, something of this sort would appear to have already been accepted by the man in the street. But in its explicit form it may indeed throw light on many dark places.

However, before admitting any such law as co-ordinate with the others so far specified—output, control, retentivity, fatigue, and noegenesis—we have still to ask whether, like these, it can be accepted as fundamental.

Consider the typical instance where the love of a mother for her child arouses her anger against an interloper. Here, the desire for the welfare of the child prompts to the desire for incapacitating whatever is opposed to this welfare. In the main, then, we have here nothing more than a straightforward application of means to an end. And this seems to be an achievement completely covered by the "noegenetic" laws already set forth in the preceding chapter. Thus the mother has only to cognize, however obscurely, the two main facts. Firstly, that the interloper constitutes a menace to the desired welfare of the child, and secondly, that an attack on the interloper will remove this danger. Both cognitions fall at once under the law of knowing relations (Chapter XXXIV). More complicated cases might involve the law of correlates.

Essentially, then, the whole proceeding is not orectic at all, but *cognitive.*

§ 4. *Psycho-analytic "Mechanisms"*

At this point we may consider for a moment what, if any, contributions to the laws of orexis have been

supplied by psycho-analysis; in particular, by the so-called "mechanisms", which play such a large part in this doctrine.

A leading case is that of what are called the "defence reactions". An example of this is the universal tendency to forget whatever is against one's interest to remember. Here is an instance reported by Jung:

> "Mr. Y falls in love with a lady who soon thereafter marries Mr. X. In spite of the fact that Mr. Y was an old acquaintance of Mr. X, and had business relations with him, he repeatedly forgot the name, and on a number of occasions, when wishing to correspond with X, he was obliged to ask other people for his name."

Another example is the general tendency to put the blame for anything on other people, a tendency that leads to disturbing suspicions and, in extreme cases, to ideas of persecution. Yet another example is the so-called "shut-in" reaction, whose manifestations may vary from the mild form of sulks to the terrible malady of dementia praecox. One more example is that of voluntary or involuntary disablement. Cases of this kind abounded during the War. The following is a case reported by T. V. Moore from school life:

> "One boy that I examined had a convulsive seizure the second day he had to go to school, just as he was going out of the front gate. His mother ran out to him, picked him up, nursed him, fondled and petted him, and fed him daintily for several days thereafter. The consequence was that every time he was sent to school thereafter he had another convulsive seizure with a repetition of the coddling treatment. In this way he managed to avoid school altogether and at seventeen could not read or write."

Now there seems no doubt but that under this name of "defence reactions" a great deal of valuable psychological, and especially psychiatrical, work has really been accomplished. But it is another question whether it

involved any new principle. In fact, any such claim would appear to be unfounded. A defence reaction, as its very name implies, is an action taken in order to comply with already existent aversion; it is, then, nothing more than a means to an end; just as in the cases already quoted in this chapter, it is essentially not orectic, but only cognitive.

After the defence reactions, we encounter most often in psycho-analysis the "compensations". One well-known case is that of day-dreaming. William Brown describes this as follows:

> "They build 'castles in the air' or 'castles in Spain,' which express and to some extent gratify the desires that remain ungratified by the course of real life. The weakly boy pictures himself as the hero of the athletic field; the dullard pictures himself carrying off the prizes at school or college. . . . In adolescence the day-dreaming is apt to take on a more romantic colouring and, of course, in some cases, to become distinctly sexual."

But here again the very word "compensation" indicates that the activity manifested is only a substitute for other activity, only a means to an end once more.

From "compensation" it is but a small step to "sublimation", a process wherein a motive of primitive order is replaced by a higher one; as when sexual impulses are diverted into intellectual love, or into artistic creation. This time there seem to be two different influences at work. One is only the same as before; the "sublime" activity may be only a way of obtaining enjoyment when the more primitive way is somehow blocked. The other influence consists in a transfer of energy, this being diverted from the lower to the higher channel. Even this time, there is in principle nothing new; the case is covered by the Law of Constant Output.

Let us pass along to the famous phenomenon of "rationalization", when a person, unaware of, or perhaps

even ashamed of, his real motive, invokes quite a different explanation. This event has been finely analysed by Hart into three stages: perception, conservation, and reproduction; all obviously covered already by the preceding cognitive laws.

As for the various psycho-analytic "distortions", such as "condensation", "displacement", and "symbolism", these have long been well expounded in the psychology of memory.

On the whole, then, none of these psycho-analytic activities would seem to require the invocation of any laws other than those enunciated already.

§ 5. *Law of Impulses*

After all, however, the "organization", "sentiments", "orectic logic", and "mechanisms" deal only with the sequence of one orectic activity after another. They therefore do not touch the question as to how such doings ever begin. Now we have already seen that the starting point of doing lies in knowing (Chapter XXV). We are thus led to consider the sequence of orexis after cognition. In what fashion, if any, has *this* kind of sequence been brought within the scope of law?

An outstanding answer has been supplied by Aveling, under the title of the "principle of instinctive conation". With some abbreviations, it runs:

> "All living organisms evolved to the perceptual level, tend to strive towards specific ends, when excited by the presentation of a stimulus co-ordinated with such a tendency."

By presentation of a stimulus, the author evidently means sensory perception. And if we generalize his principle so as to include the level of thought, we arrive at the proposition that *all striving is originated by some perception or thought of a goal.*

How far does this satisfy the scientific requirements? Of all the objections which might be raised against it, many can be more or less easily overcome. There is, however, here again, an indefiniteness introduced, which cannot but greatly diminish the power of prediction. What kind of percept or thought is it, we must ask, that thus functions as goal or purpose? Aveling answers this question as follows:

> "Every living organism tends towards preserving its own integrity."

But he wisely adds that this principle is not psychological; only biological.

He attempts another answer:

> "That value is always determined as a motive which best accords with the disposition of the Subject."

But here again he himself supplies the most trenchant criticism. Such a law, he says, would go beyond the psychological evidence now available or ever likely to be so.

Yet another great difficulty in expressing the original source of orexis in the form of a law confronts us in the fact that orexis includes not only volition but also feeling. Is pleasure, too, directly excited by perceptions or thought? Such kindred questions, together with their limitless corollaries, have contributed richly to the literature—especially ethical—of all ages. As an example we may quote the following law enunciated by Bonnet:

> "A sentient being can only be determined to act by virtue of experiencing a perception or a sensation that is agreeable or disagreeable."

But for any consensus of opinion we may still search in vain. Here once more, then, the reduction of human motive to law appears to remain still very incomplete.

§ 6. *Law of Will*

We have still to take into account the "Charioteer" of Plato and the "Will" (*Voluntas rationalis*) of Aquinas. The very existence of such things, familiar enough to common sense, has always been vehemently and even scornfully rejected by a large proportion of scientific psychologists. But recently, as we have already seen, it has received new support from the side of experimental introspection. And furthermore, as we shall find later on (Chapter XLI), it has been still more cogently reinforced from the side of actual function.

Accordingly there is some ground for advancing—provisionally, pending further evidence—a law on some such lines as indicated by Lotze :

> "Superposed on the experiences named impulses, there may occur an approval, adoption, or endorsement of any of them, this superposed activity being what is commonly called an act of will."

§ 7. *Secondary Laws*

We have been considering only the orectic laws which lay claim to be most fundamental. What about those which are somewhat less so ?

Certainly, formulations have been attempted for these also. One single author, Shand, has supplied us with no less than a hundred and forty-three. In fact, he seems to suggest that we can at least get one from each relevant statement of "all dramatists, historians, biographers, and novelists". These preliminary laws he ingeniously proposes not to prove but to amend :

> "If we had to establish the truth of these initial conceptions in the first instance, we should not make any advance at all. Subtle questions would have to be considered, and different minds would furnish divergent

answers to them. We have to adopt these conceptions in the first instance, as part of our working theory."

"Will it help us to organize these laws so that we can make a science of them, wherein the truth of one supplements, supports, or throws light on the truth of others? If it can do any of these things it will justify our use of it as a hypothesis; if it can do all of them, it may establish its own truth; if it can do none, though it be still true, it is unfruitful, and we must find some other hypothesis."

As an example of the original formulations, he gives us the following passage from Bacon:

"Deformed persons and eunuchs, and old men and bastards, are envious."

His treatment of this assertion consists in applying it to the observed facts, noticing the cases which fail to agree with it, and then restating the law so as to exclude these exceptions. By successive limitations of this kind, he eventually brings down his law to the following formulation:

"Defects and inferiorities which both arouse the sentiment of pride and are felt to be irremediable tend to make us envious of those who do not suffer from them."

He himself criticizes such a law aptly enough:

"We can never be sure that we have discovered all the conditions that limit its truth, and therefore all our laws remain tentative and hypothetical."

Nevertheless, the author can hardly be denied the credit of having extracted an array of formulations which, if hardly at present attaining to the status of scientific laws, still supply at least a wealth of material and encouragement towards this end.

§ 8. *Upshot*

On the whole, we have found several efforts to extend the reign of scientific law even to the extremely difficult

sphere of orexis. The most explicit attempts in this direction have been the so-called "Law of Organization" and the kindred "sentiments", both being really revivals of the orectic theory of Aquinas.

However, we found that the essential facts here at issue (as also the "mechanisms" of psycho-analysis) are firstly not orectic at all, but cognitive, and secondly, are well covered by the laws given already.

Genuinely orectic and new, on the other hand, did seem to be what we called the laws of impulse and will. But these appear to be still so indefinite and disputed, that their scientific status is more a promise than an accomplishment.

CHAPTER XXXVI

LAWS OF BASAL CONDITIONS

§ 1. Limitations of Preceding Laws. § 2. Direct Influence of Body on Mind. § 3. Influence of Sense Organs. § 4. Influence of Glands and Health. § 5. Influence of Age. § 6. Influence of Heredity. § 7. Influence of Sex. § 8. Law of Basal Conditions. § 9. Composition of Causes. § 10. Upshot.

§ 1. *Limitations of Preceding Laws*

So far, this section has been devoted to the consideration of the regular sequences of one mental experience after another. But what, then, about those experiences which come first? These must necessarily be evoked by something else; by something that in a certain sense lies deeper.

An outstanding instance of such an initial mental experience is that of primitive sensation. This seems to come as a bolt from the blue. Apparently, it has no indispensable mental antecedent whatever. A more dubious instance of initial experience is that of feeling.

Another way in which our mental laws fail to touch bottom is, in respect of quantity. Take, for example, the law of dispositions, which asserts that the occurrence of a mental event tends to make it subsequently occur with greater ease. As to how great this tendency is, the law is silent. For all that it says, the tendency may be far stronger in one individual than in another. It may even have different magnitudes in the same individual at different times.

As another instance consider the case where anybody perceives that the two tones, *c* and *g*, have the relation of a musical fifth. The perception of the relation will indeed depend largely on the mental laws which we have set forth; qualitatively on those of noegenesis; quantitatively, on those of output, control, retentivity, and fatigue. But imagine two different persons to be exactly equal in all those four respects. They may be still very unequal in ability to perceive the relation; for the one person may be innately more gifted than the other. And even when the two are equal in this respect also, one of them may have had his ability lowered by disease.

§ 2. *Direct Influence of Body on Mind*

In short, then, it would appear that all the laws given in the preceding chapters and expressed in terms of mind are far from adequate to account for the whole of mental experience; accordingly, there seems to be no escape here from taking the influence of the body also into account. How has this extension been carried out? How should it be?

In reply we may here recall the vital distinction which has had to be made between the direct and the indirect connection of the body with the mind (Chapter II).

As regards the direct or immediate influence, this has been considered in Chapters II and III. The attempts to discover it have been of various kinds. Philosophy has contributed such suggestions as Interactionism and Parallelism. Physiology has worked at the manifold problems of cerebral localization. Experimental psychology must be credited with the logarithmic law of Fechner. The disappointing inconclusiveness of all this work has been set forth by us already.

§ 3. *Influence of Sense Organs*

Let us turn to the cases of indirect influence ; to those where the influencing and the influenced occurrences are not in contact but separated by intermediate links. Here the contributions which have been made by science, psychological and physiological, are, without exception, immense.

A pre-eminent instance is furnished by sensation, especially of the most primitive kind. In this, at least four stages have been distinguished : A, stimulation of the sensory organ ; B, conduction of the stimulus on to the sensorium ; C, excitation of the sensorium ; D, emergence of the mental sensation. Here, the influence of C upon D is what we are calling direct ; for it, no laws are as yet known ; we do not understand enough about the nature of C. But where we do find the establishment of laws—extremely numerous and even approximately exact—is about the influence of A upon D.

In the case of vision, for example, we come upon such theorems as the following :

> The experience of colour depends on stimulation of the retina by ether waves.
>
> The quality of the colour depends on the length of the waves ; the intensity, on their amplitude.
>
> Simultaneous excitation of the same retinal points by waves of different lengths renders the colour sensations less saturated.

Here are some more laws, taken this time from hearing :

> The experience of sound depends upon the stimulation of the ear by vibrations of matter ; in general, by those of the external air.
>
> Simple pendular vibrations produce sensations of tone, greater wave-length, making this lower, and greater wave-amplitude, making it louder.
>
> In the case of complex vibrations, their form governs the tonal timbre.

In the case of sensations of pressure, warmth, cold, and pain, we learn that these are excitable with weakest stimuli at certain discrete " spots " distributed in immense multitude over almost the whole of the skin (see Chapter XIII).

With the sensations of taste and smell, we learn that the former derive from stimulation of sensory nerves on the tongue, whereas the latter come from a small area of the nasal mucous membrane.

Besides many other laws of narrower range there are a few broader ; for instance, the law of Weber :

> In order that a sensation shall be rendered just noticeably more intense, its stimulus must be increased by a constant fraction of itself.

Again, there is that of J. Müller :

> Every effective stimulus of any nerve invariably invokes sensation of one and the same kind, which is thus specific to that nerve.

§ 4. *Influence of Glands and Health*

The preceding influences of body on mind have had their main source in stimulations from the external environment. But even more potent effects have been found to derive from internal sources ; especially from the glandular secretions. Of the glands chiefly in question, the " thyroid " consists of two brownish tissues across the neck and above the windpipe. The functions of their secretions have been described as acceleration, lubrication, and transformation of energy. When the secretion fails (as in the case of cretins) the person becomes apathetic, dirty, awkward, and even idiotic.

Another of these glands is the " pituitary ", a piece of brain no bigger than a pea situated behind the root of the nose, and containing two parts called prepituitary and

postpituitary. Deficiency in one or both of their respective secretions is said to make a person slow, dull, and sexually inactive.

Yet another such gland is the " adrenal ", which lies above the kidneys ; it also has two parts, the cortex and the medulla. Disturbances of this gland produces sexual anomalies. A woman may be turned into a bearded, muscular, courageous " virilist " with immense capacity for work, but neither having nor desiring attraction for men.

Still more control over sexual life has been attributed to the " gonads ", which in the male person are the testes, and in the females, the ovaries. Berman describes their effect on the female as follows :

> " A woman who has a delicate skin, lovely complexion, well-formed breasts and menstruates freely will be found to have the typical feminine outlook on life, aspirations and reactions to stimuli, which, in spite of the protests of our feminists, do constitute the biological feminine mind. Large, vascular, balanced ovaries are the well-springs of her life and personality. On the other hand, the woman who menstruates poorly or not at all is coarse-featured, flat-breasted, heavily built, angular in her outlines, will also be often aggressive, dominating, even enterprising and pioneering, in short, masculoid. She is what she is because she possesses small, shrivelled, poorly functioning ovaries."

Tremendous as may be, however, all such effects of glandular secretion upon mental experience, they remain none the less indirect. The secretion cannot be supposed to influence the mental processes immediately on its formation. Instead, it has to enter the blood and remain there till at last it initiates the almost unknown processes of the body which do directly subserve those of the psyche.

Hardly dissimilar in principle from the preceding indirect influences of the sensory stimulation and of the

glandular secretions are those of health. Indeed, there appears to be no sharp dividing line. What is known about the effect of glandular secretion on mental activity consists in little else than that any disturbance of the one produces some parallel disturbance of the other.

§ 5. *Influence of Age*

On a somewhat different level stands the influence exerted on mental experiences by a person's age. And here a distinction—easy enough in theory, but hard in practice—must be drawn between developments of two different kinds. The one consists in those changes of the later experiences which are due to the earlier ones. Such changes only take us back to our mental laws again. But the other kind of change is due solely to increasing age; it has been designated as maturation; being independent of the earlier mental experiences, it seems solely attributable to the influence of the body.

In order to ascertain pure maturation, one course has been to contrive that the possible effects of experience should be made as small as possible. Or, instead of being minimized, the effects have been maximized; that is to say, the experience has been carried to such a stage as to preclude all further change from this cause.

And in the case of the lower animals, at any rate, the elimination of change by experience has sometimes appeared feasible enough. A classical experiment was that of Spalding in 1873, when he kept some newly hatched birds shut up throughout the period during which they ordinarily seem to be learning how to fly. The result was that, at the end of the period, they could straightway fly perfectly without any practice whatever and without, it would seem, the introduction of any new experience, such as parental guidance.

Something of the same sort has been observed even

in the case of human beings. Upon one occasion a child was not allowed to walk in the normal learning period (from the seventh to the eleventh month). Then at last it was permitted to try. It forthwith showed itself able to walk as well as if it had had normal practice. Another instance has been furnished by a six-months-old child of the present writer. Up to that age her behaviour had been uniformly placid. But then for some reason or other our physician undertook a rather searching examination of her mouth. Thereupon without training or even warning she started a highly co-ordinated system of hostile movements that might be called "flying at" the offender.

It is interesting to note that the movements of the infant were such as conceivably *might* have been acquired by dint of long pugilistic experience. The suggestion arises that similarly not a few of the complex activities of a child, which rationally *might* have been built up by previous experience, are really supplied all ready for use. In the interest of survival, nature may take short cuts.

By one way or another, psychologists have arrived at enunciating quite a formidable array of laws about the effects of age. Let us cite some examples. The careful observations of Miss Shinn emboldened her to describe the normal mental growth during the first six months of life as follows:

> "The babe drifts softly in among phenomena, wrapped away from their impact in a dim cloud of unconsciousness, through which but the simplest and faintest gleams and echoes make their way to him. Then month after month the multiplex vision without clears itself from the background of cloud, bit by bit, everything grouped and ordered for him in the very process of coming to his consciousness—a wonder and a joy to him, and the most beautiful of all unfoldings to see."

From this time to the beginning of the third year she

could only record in sensory development:

> " Growing clearness in visual definition,"
> " Growing sensibility to pain," and
> " Gradual acquirement of size and distance interpretations." And now
> " The child has practically the same senses as an adult."

As regards later life, more and more attempts are made by psychologists to establish laws about the development of the psyche. Such theorems are asserted as that inborn " general ability " attains its full growth at about fifteen years of age. But about special abilities—for instance, the development of language, or of memory—there is still no great effort made to distinguish the pure maturation from the improvement due to experience.

Further research has yielded such doctrines as that children begin by taking all objects to be animate, and only after several years arrive at regarding them as inanimate. Or that a pre-school child's construction of material objects is mainly symbolical, and only afterwards becomes real and utilitarian. Another fruit of study of maturation is that a child's first response to other human beings is " positive " ; that he smiles when spoken to, and spontaneously seeks contact with those who approach. Not for about six months does he react " negatively " with flight, defence, or attack.

Yet another theorem is the following:

> " By about the seventeenth year the individual matures in two spheres of paramount importance ; his love life and his work life."

Altogether, the influence of age appears to afford scope for numerous laws. And some of these even attain to considerable definiteness. But in most cases there still remains great difficulty in separating the changes due purely to maturation from those which may rather be ascribed to experience.

§ 6. *Influence of Heredity*

Another influence which here concerns us, and possesses, moreover, paramount interest, is that of heredity. Has or has not this also furnished psychology with material for scientific laws?

Here, at least two chief methods have been available. The one is to estimate the effects of experience upon any person, and then to credit everything else about him to inheritance. Seemingly, a proceeding not without danger.

The other method is to compare together different persons; either those who have had different inheritance but similar environment, or else those of different environment but similar inheritance. The latter situation has been sought by comparing together siblings—if possible, twins—who have been brought up in unlike surroundings.

The principal conclusion reached about the influence of inheritance relatively to that of environment has been that the two do not act separately, but in combination. Instead of some activities being controlled by heredity and others by experience, every activity is more or less controlled by both factors. Doubtless, the conclusion is profoundly true, but not very novel. It has been reiterated from the earliest times, at any rate as far back as Plato.

With regard to further results about the influence of heredity, these are—as compared with those about age—lamentably meagre. The investigation of the topic has turned out to bristle with disconcerting difficulties.

Perhaps the most promising line of investigation so far tried is the work on twins as initiated by Thorndike and admirably developed by Freeman and Holzinger.

A much easier problem than the study of the heredity of human beings is that of lower animals. But even here

the obstacles to research have shown themselves to be formidable enough. Witness the heated controversy as to whether any tricks taught to rats are in appreciable degree transmitted to their later generations.

§ 7. *Influence of Sex*

Comparatively free from such difficulties, however, has proved to be the study of the influence of sex.

In this domain the most outstanding result of research has been of a negative kind. It runs to the effect that in mental abilities—unlike muscular strength—the difference between the two sexes is surprisingly small. In general, and on an average, the boys seem to be a little ahead until about eight years old, the girls then surpassing them up to about twelve years, whilst thereafter the boys begin to get a little advantage. But throughout, the best boys seem to be ahead of the best girls, and the worst boys behind the worst girls.

As regards special abilities, females are reported to be generally superior in discriminating colour and in memorizing passages of prose; where the boys do better is in such spatial performances as engineering and also in logical reasoning.

But as to the still more vital differences that occur in respect of orexis, psychology seems to have made little or no advance beyond common sense.

§ 8. *Law of Basal Conditions*

Let us for a moment bring all the cases of the present chapter together. They have in common the fact of being additional to those which are explicable by the laws given in the preceding chapters.

Are they then, as has been charged against them, just an *omnium gatherum*? Do they resemble the final

clause in a legal deed which, after all the known conditions have been specified, tries to bring in somehow those which were unknown? Are they after the fashion of old Sirmond:

> "If on my theme I rightly think,
> There are five reasons why men drink,—
> Good wine, a friend, because I'm dry,
> Or lest I should be by and by,
> Or any other reason why"?

To rebut this charge against the cases superadded in the present chapter, it may be urged that they are in truth no mere miscellany, but an indispensable class with well-defined characteristics.

As already stated, all the other laws expressed sequences within the sphere of mind; one mental occurrence was said to be affected by some previous one. But such a chain of mental sequences must needs have a beginning; that is to say, it must start out of something that is not mental. And this something, we may presume, is bodily. Before all the sequences in which mental events are preceded by mental ones, must have come those in which they are preceded by bodily ones.

Now, up to the present day there has been little success in the quest after *direct* sequences of this latter sort; but a wealth of information about *indirect* sequences, such as stimulus-sensation. Many of these have been indicated in previous chapters. In this one we have encountered further sequences still more indirect. We have dealt with such influences as those of age, heredity, and sex which are hard to trace back to any definite bodily origin at all, but yet must be assumed to have such an origin.

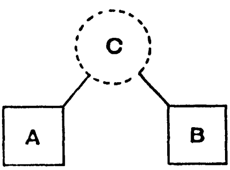
On the whole, then, we must conclude, as on a previous occasion (*Abilities of Man*, p. 360), that:

> "There is one more quantitative law of knowledge besides the four that we have so far been considering

(span, retention, fatigue, and conation). It has been called that of ' primordial potencies ', and formulated as follows. *Every manifestation of the preceding four quantitative principles is superposed upon, as its ultimate basis, certain primordial but variable individual potencies.*"

§ 9. *Composition of Causes*

Among the most acute criticisms that have been made of the preceding laws is the objection of Hazlitt, that they do not fully determine the result; she writes :



" Even such simple and diagrammatic characters as A and B stand to one another in more than one relation, e.t. A = B, B is to the right of A, A is similar to B in shape, etc. Which of these relations shall be known when the two are presented ? "

But to this objection Thomas has made the following reply :

" . . . In all such cases the particular relations educed will be determined by the quantitative laws. Previous facilitation of one relation may cause that to be educed first ; fatigue may even inhibit them all ; perseveration of one may inhibit the others ; volitional control may play, as we shall see shortly, an immensely important part in bringing about the eduction of one relation rather than that of another ; and so on."

However, Hazlitt pursued further this question as to how the total result of all the co-operating laws is finally determined. Her argument was as follows :

" The laws as they stand ignore ' the relevance of the relations educed to the given task.' The really ' intelligent ' person is the one who educes the relevant rather than the irrelevant relations."

But Thomas answers that the very word " relevance "

signifies relationship ; so that the cognition of relevance does itself essentially come under the law of relations. For fuller consideration of this and other critical points, however, reference must be made to his own work.

In general, each law is defined as expressing only an ideal *tendency*. This means that none of them should be expected to occur in isolation from any of the others, but always in the most intimate conjunction. For instance, it would be manifestly absurd to infer from the law of output that a person has equally rich mental experience when awake and when asleep. All the law says is that his output will remain constant so long and only so long as there is no change in the other four quantitative variables (control, retentivity, fatigue, and basal conditions). In fact, the situation could be expressed by saying that by the four variables the mental quantity is completely determined.

We may perhaps add the remark that, throughout the enunciation of the several laws, no commitment has been made as to the manner of their co-operation. As we have already seen (Chapter XXVII, pp. 12-13), this presents three main types, designated respectively as " mechanical ", " chemical ", and " conjoint ". Simplest is the mechanical kind, where the effects of the partial causes are merely added together. And this kind of composition, though seldom true exactly, is very often a good first approximation to the truth.

§ 10. *Upshot*

To summarize the yield of this whole section, no good reason has been found for the pessimism which would deny to the study of the psyche all possibility of being developed along the lines of genuinely scientific laws. On the contrary, we have found that most cases have been more or less satisfactorily treated in this manner.

The mental items revealed by analysis and synthesis in Part C have in the present Part shown themselves to follow laws of sequence that comply, in varying degrees, with all the conditions demanded by science. The whole scheme of laws may be arrayed logically as follows:

LAWS OF MENTAL SEQUENCE

I. *Primitive States.*

II. *Cognitive Quality.*
  (1) Knowledge of Experience.
  (2) Knowledge of Relations.
  (3) Conception of Correlates.

III. *Orectic Quality.*
  (1) Impulse.
  (2) Will.

IV. *Quantity* (cognitive and orectic).
  (1) Output.
  (2) Control.
  (3) Retentivity.
  (4) Fatigue.
  (5) Basal Conditions (body-mind).

With particular reference to the said quantity, we may recall here that so far as concerns elementary observations (as opposed to calculations and hypothesis) this has three dimensions, namely, intensity, clearness, and speed (see Chapter XV).

Also, it may be remarked that all these general laws, like those of the physical sciences, require to be supplemented by an indefinite number of more specific sub-laws. Indeed just these are most immediately applicable to scientific purposes (Chapter XXVII, p. 15).

In conclusion, a word may be said on the fashion in which this whole noegenetic theory has been generally received. Contrariwise to its kinsman, the theory of

Two Factors, it has been little attacked but largely ignored. But this aloofness towards it has been becoming harder to maintain, in view of the rapidly increasing array of its explicit supporters; such as, for example, Aveling, Ballard, Brown, Cattell, Flugel, Nunn, McDougall, and Stevanović (not to mention the present writer with his students). And in the last few years it has advanced to the stage of constituting the very foundation of psychological study. Wynn Jones, for instance, in his *Theory and Practice of Psychology*, 1934, sets out from the proceeding Laws as his general basis (pp. 4-6, 32-34). Then 1935 saw the appearance of the *Ability and Knowledge* of Thomas, which is built up on a surprisingly simple exposition of the Laws, followed by a delightfully humorous account of the objections which had been brought against it. Finally, acknowledging inspiration to Wild's "enthusiasm for noegenetic psychology", Frances Banks generously writes in her own *Conduct and Ability*, 1936, as follows:

> "It is no exaggeration to say that to pass from the old type of text-book, with its descriptive comments on perception, imagination, thought and allied processes, based on the associationism which it professes to deny, and to become for the first time acquainted with the cautious lucidity of the (noegenetic) theory, is like the emergence from a smoky tunnel into clear mountain air; the experience is at once rational and aesthetic."

E

WHAT GOES WITH WHAT

CHAPTER XXXVII

FACULTIES PAST AND PRESENT

§ 1. Common Sense. § 2. The Faculties Again. § 3. Range of Possibilities. § 4. Differences in Knowing. § 5. Differences in Doing. § 6. Differences in Feeling. § 7. Oddments. § 8. Temperaments. § 9. General Quantities. § 10. A Vital Flaw. § 11. Upshot.

§ 1. *Common Sense*

The preceding portion of the book has been devoted almost exclusively to the science of the psyche in general. Part A dealt with some preliminary considerations about this psyche, Part B turned to inquire what Powers it possessed, Part C examined its Constitution, while Part D was occupied with its governing Laws. In the present Part we are to consider, not what is general, but what is individual; not that wherein people agree, but that wherein they differ.

Herewith we enter into a realm where the plain man feels specially at his ease. Much of his daily talk is devoted to making comparisons between the abilities of different persons. He declares certain of them to be more intelligent than others. He credits one with some superior technical skill, such as in the handling of an engine; a second with exceptional talent in music or in painting; another with pre-eminence in any popular game. Teachers make such ratings in order to guide them in the exercise of their vocations. Business men do as much for the purpose of selecting their employees.

Nor is this concern for individual differences any new

product of advancing civilization. With little if any obvious inferiority, it goes back as far as do human records. Even the most primitive races and very young children manage to distinguish individuals in respect of character and ability with surprising acuteness. The respect in which common sense does break down—here as elsewhere—is that of system. It has notions in great abundance; but they tend to be obscure, chaotic, and even contradictory.

This interest in differences between one person and another continues unabated when we pass from the views current in the streets to those which are pronounced with some degree of authority, even if this be not quite equal to that of academic teachers. Among such utterances may be reckoned fables, proverbs, sermons, essays, histories, and newspapers. Most finely delineated of all, perhaps, are the individuals presented in fiction.

Not a little inspiration, moreover, has come from theological interest, as in the following utterance of Archbishop King two centuries ago:

> "A perfect equality in the capacities and functions of created beings . . . is impossible even in idea; for such an equality would prove destructive of all those notions we entertain of the subordination and wisdom so requisite for the government of the universe, and which we consider as necessary attributes of Divine Intelligence."

§ 2. *The Faculties Again*

This lively concern which has always been displayed for individual differences by people at large may be contrasted with the comparatively late interest which has been shown in them by most of the professed psychologists.

This neglect called forth, for instance, the following complaint from Bacon:

"The first article of the culture of the mind, will regard the different natures or dispositions of men. And I cannot sometimes but wonder that this particular should be so generally neglected. And this subject of the different characters of dispositions is one of those things wherein the common discourse of men is wiser than books—a thing which seldom happens."

§ 3. *Range of Possibilities*

However, before proceeding to consider what the psychologists have really had to say on the matter, we may note, to begin with, that individual differences have definitely limited general possibilities. In particular, they can in no way transcend the scope of that which is, or ought to have been, included in the preceding chapters.

Qualitatively, this general limitation is obvious enough. If Part C truly and exhaustively presents all the items of which the psyche is constituted, then clearly it must comprise every item wherein one psyche can differ from another.

But on a little reflection, the same limitation may be seen to hold good also on the quantitative side. For in so far as Part D is complete, it indicates all possible determinations of the mental items, and therefore all differences of mental quantity.

And this applies alike to intensity, clearness, and frequency. Furthermore, it remains equally true whether the determination does or does not derive from any influence of experience. Not only does it comprise the differences that arise through the agency of retentiveness, fatigue, span, conation, or noegenesis; it no less exhaustively covers all such influences as heredity, age, health, and so forth. In this fashion, we already know how individuals conceivably *can* differ from one another. For us, then, is only left the task of picking out the respects in which they actually do so.

§ 4. *Differences in Knowing*

Now, when the psychologists did, as such, begin to contribute to the topic, their starting point was, naturally enough, the doctrine they had evolved already. The study of mental individualities, no less than that of mental generalities, developed out of the " faculties ". When once a faculty is believed to exist, it is naturally enough taken to be possessed by different persons in different degrees.

In the case of the faculty of Intellect, indeed, this inference does not appear to have been usually drawn. True enough, the difference between human beings and the lower animals has always been noted, and perhaps even exaggerated. Thus, in the very earliest writings, the faculty of Sense was taken to be common to man and beast, whereas that of Intellect was ascribed to man alone. But we hear little, if anything, about this intellect varying either qualitatively or quantitatively from one man to another. A notable exception is Aquinas, who does consider with much care :

> " Whether one person can understand one and the same thing better than another can."

And here too, interestingly enough, recourse is at once adventured to physiology :

> " Because some men have bodies of better disposition, their souls have a greater power of understanding, wherefore it is said that *it is to be observed that those who have soft flesh are of apt mind.*"

As regards Sense, however, neither the large individual differences nor their physiological origin could be overlooked by anyone. In some measure, the same thing may be said of memory. We have met with an instance in Aristotle's belief that dwarfs are more forgetful than other men because with them the upper part of

the body presses too heavily on the heart (which he took to be the organ of consciousness).

In due course, the other classical faculties followed suit. Imagination, Attention, Desire, Feeling—all showed unmistakable indications of varying from one person to another.

Still later came the day when the supreme individual difference was taken to be in respect of Intelligence. And so the circle has been completed. Starting from the Intellect, the faculty which above all others brings man and man together, we conclude with the Intelligence, which most of all keeps men differentiated!

In comparatively modern times, the doctrine of individual differences of ability reached its peak of elaboration in the phrenology of Gall, Spurzheim and Combe, with their varying faculties of individuality, form, size, weight, colour, locality, eventuality, causality, and many more (see Chapter X). Here once more the traits were confidently supplied with an anatomical and physiological basis, the well-known "bumps" on the head.

§ 5. *Differences in Doing*

Turning from cognition to volition, we have already found that many attempts have been made to draw up a list of all the pursued ends. We saw the great choice between the Good, the Pleasant, and Self-preservation. We recalled the long enumeration supplied by Bentham of the Springs of Action. Then we passed to the more modern categories of McDougall, Spranger, Klages, and so forth. But be the different propensities what they may, there seems to have always been an assumption or implication that they exercise unequal influences on different individuals. If the good was cultivated, or at any rate recommended by Plato, the pleasant was no less strongly preferred by Aristippus.

Further individual differences have been taken to lie in the degree that any or all of these Ends are under the control of the "Will", if such a thing be allowed to exist. Often, too, nearly the same fact has been expressed by saying that the personality of one person is more "integrated" than that of another.

§ 6. *Differences in Feeling*

As much may be said for the third of the most commonly admitted divisions of the mind, namely, feeling. Even if this, as by Titchener, is confined to the single dimension happiness-unhappiness, still one individual is taken to lie nearer to one extreme, another to another. And the same occurs if, as by Wundt, the dimension is tripled; thus, different individuals are believed to be unequally prone to feelings of excitement, of tranquillity, of tension, or of relaxation.

§ 7. *Oddments*

Over and above all the preceding individual differentiations which lie more or less along the lines of the ancient parts and faculties of the psyche, innumerable others have been obtained by some other usually rather odd way of subdivision, combination, or cross-section.

One notable class of cases is when the absolute intensities, clearnesses, and frequencies of knowing, doing, and feeling are replaced by the *relative* quantities of these.

An instance of this class occurred when Bain, in 1861, depicted individuals as inclining in one or other of the three cardinal directions; intellectual, volitional, or emotional. Among his successors in this respect may be mentioned Fouillée (1893). Malapert, however, managed to introduce a fourth direction, making in all: "intellectual", "affective", "active", and "volun-

tary". Jordan, on the other hand (1890), cut out one direction; he divided mankind into two classes according as they incline more to "action" or to "passion". A couple of years later Ribot in France made a similar classification. So, too, Heymans and Wiersma in Holland (1906) took individuals to be fundamentally differentiated according to whether they were prone to "action" or to "emotion". It is the old story of Martha *versus* Mary again.

Queyrat, however, rendered the matter more complicated (1896). Setting out from the three classical tendencies, cognitive, affective, and active, he characterized one class of persons by the dominance of only a single one of the three; another class by the joint dominance of any two of them; and a third class by the equable balance of all three together.

Even this, however, had been anticipated and even surpassed by Fourier already in 1851. Here, we find twelve "radical passions". The individuals dominated by any single one of these are called "monogynes" and exist to the number of 576 per population of 810. Those individuals having two dominants, the "digynes", number 288. The "trigynes", "tetragynes", and "pentagynes" number respectively 12, 4, and 1. Thus, to say that the monogyne "Apicius" is endowed with the dominant of taste and the subdominant of ambition means that he has certain aspirations but not strong enough to overcome his gourmandism.

Sometimes, only one dominant is conceded and the individual differences are attributed to the diverse possible manifestations of this alone. Thus, Freud declared that the single interest in the sex impulse and the excretory functions can be converted into the manifold traits of orderliness, of parsimony, and of stubbornness. Ernest Jones extended the list of derivatives from this strange source almost endlessly; he writes:

"It will be seen that the total result is an extremely varied one, owing to the complexity of the interrelations of the different anal-erotic components with one another and with other constituents of the whole character. Some of the most valuable qualities are derived from this complex, as well as some of the most disadvantageous. To the former may be reckoned especially the individualism, the determination and persistence, the love of order and power of organization, the competency, reliability and thoroughness, the generosity, the bent toward art and good taste, the capacity for unusual tenderness, and the general ability to deal with concrete objects of the material world. To the latter belong the incapacity for happiness, the irritability and bad temper, the hypochondria, the miserliness, meanness and pettiness, the slow-mindedness and proneness to bore, the bent for dictating and tyrannizing, and the obstinacy, which, with the other qualities, may make the person exceedingly unfitted for social relations."

§ 8. *Temperaments*

In contrast with all these more or less sporadic, irregular, and perhaps even freakish teachings of individual psychology, there has from the most ancient times been one really systematic and comprehensive development of it. This is that of the far-famed mental "temperaments".

Specially characteristic of these is the fact of their having been based upon the constitution and function of bodily "humours". Parmenides, Alcmaeon, and Empedocles conceived the view that health depended on preserving the proper proportions of the elements in the body, and especially in the blood. The elements themselves were originally most often supposed to be earth, air, fire, and water. After such precursors, the doctrine was advanced by Hippocrates, in the fifth century B.C., that the body contained four humours, each

possessing a characteristic elementary quality. The first humour was the blood, to which was attributed the quality of moisture; it was called "sanguine" (Latin, *sanguis*, blood). The second humour was the phlegm, which was regarded as dry; to it was given the name of phlegmatic (Greek, *φλέγμα*, fire). The third humour was the yellow bile, with the quality of coldness and the name of choleric (Greek, χολή, bile). The fourth humour was the (supposed) black bile, having the quality of warmth and named melancholic (Greek, μέλαινα χολή, black bile).

But so far as concerns psychology, the influence attributed to Hippocrates seems to have been exaggerated. Not until the time of Galen, seven hundred years later, do we hear of these four humours being taken in special connection with emotional tendencies. But now the qualities ascribed to the humours are revolutionized. To each of these is assigned not one quality but *two*. The sanguine is warm and moist; the phlegmatic, cold and moist; the choleric, warm and dry; the melancholic, cold and dry. From these redistributed qualities it is that he reached psychology. Warmth brings courage, quarrelsomeness, and energy. Cold makes for slowness and clumsiness. And upon this basic constitution of warmth or cold certain modifications are superimposed according as the humours tend to dryness or to moisture. From this elementary simple scheme of the humours Galen proceeds by way of combination to fifteen others of greater complexity, thence again he reaches thirteen mental temperaments. For instance, the "melancholic" person when excited is said to be "cheerful and inclined to sing"; the "sanguine" person is "simple and silly".

A millennium later still, we find that the mental interpretation of the temperaments has again changed, and has in fact approximated to present usage. As for their

physiological aspect, this is described more graphically and emphatically than ever. Thus Burton writes:

> "What can be more ignominious and filthy than for a man not to know the structure and composition of his own body?"

Accordingly, he proceeds to explain that the (fictitious!) "black bile" accountable for "melancholy" is "cold and dry, thick, black and sour, begotten of the more feculent part of nourishment and purged from spleen".

Comparatively soon afterwards, however, the whole of this two-thousand-year-old and so much prized psycho-physiology of humours was thrown overboard. With Rüdiger early in the eighteenth century they were replaced by two gases, aether and air, the former being the cause of light qualities and the latter of heavy ones. As either element may or may not be "refined", there ensues a neatly ordered scheme.

Aether	*Air*	*Temperament*
refined	refined	sanguine
unrefined	unrefined	phlegmatic
refined	unrefined	choleric
unrefined	refined	melancholic

However, the physiological hypotheses soon changed again with Stahl and with Haller; both humours and gases as bases of the temperaments are displaced by Solids; whereas with Wrisberg, a disciple of Haller, the physiological basis becomes the thickness of the nerves and the sensitivity of the senses. Henle, for his part, favours the tone of the nervous system as also the speed and duration of the reaction. Pilo, however, in 1892 goes right back again to the composition of the blood, whereas Fouillée in 1895 traces the different temperaments to varying stages of nutrition. Seeland in later times

attributed them to the varying kinds of vibration which are set up by external and internal stimuli of the brain tissue. Still more recently, however, the temperaments have been brought into relation with the doctrine of psycho-analysis. They are taken to spring from the varying modes of drainage of the person's psychic energy or *libido*. Finally, something like a return to the old humours has been effected; for in place of these have been substituted the "hormones" and suchlike secretions from the ductless glands.

Despite all these drastic changes in their asserted physiological bases, the temperaments in their mental aspects remained comparatively stable. Platner, indeed, took a line of his own. He arrived at four temperaments that were fundamental: the "Attic" (spiritual); the Lydian (animal); the "Roman" (heroic); and the "Phrygian" (feeble). Again, Bahnsen managed to set up no less than sixteen, these arising from the different possible combinations of four fundamental qualities: spontaneity, receptivity, impressionability, and reactivity.

But most authors have followed the traditional four in main outline, introducing only subordinate alterations. Thus in the well-known doctrine of Kant the "sanguine" and the "melancholic" temperaments are put together and assigned to the sphere of "feeling" (*Gefühl*); they are called respectively "light-blooded" and "heavy-blooded". The other two temperaments, "choleric" and "phlegmatic", are taken to be not concerned with feeling, but with "activity" (*Tätigkeit*); they are "hot-blooded" and "cold-blooded".

§ 9. *General Quantities*

However, a case of especial interest is that where the temperaments are finally reduced to the bare quantities: intensity and speed.

Thus Wundt gives us the following table:

	Strong	Weak
Quick	Choleric	Sanguine
Slow	Melancholic	Phlegmatic

Cognate are the schemes devised by Meumann, Elsenhans, Jastrow, and even—with the addition of a fifth temperament—by Ach.

But in all such cases the quantities, being taken apart from any qualities, are implied to be *general.* Herewith we reach another development of individual psychology; one that, though not ancient like the temperaments, has been going on at any rate for a century or so.

An outstanding instance has been the extremely elaborate treatment of individual differences by Beneke in 1833. It is based on three quantitative "ground-properties", which are those of "excitability", "assimilation", and "liveliness".

In 1896 this was at last followed by the six quantitative dispositions of Perez, the "active", the "slow", the "vehement", the "lively-intense", the "slow-intense", and the "balanced".

In 1900, a comparatively brief but pregnant indication was given by G. E. Müller, that one fundamental difference between individuals consists in degree of "perseveration". This he defined as a quickly lapsing tendency of any ideas, that have been brought into consciousness, to rise into it again spontaneously.

Two years later, individual differences of very great scope were attributed by Otto Gross in Austria to what he called the "primary" and "secondary" functions of ideas. By the former he designated:

> "that activity of a nervous element which indicates the rise of a presentation in consciousness."

The secondary function on the other hand was:

> "the activity which followed upon the primary one as after-function."

If this secondary function has deficient intensity and duration, then:

> "the individual loses the power to keep his thoughts in dependence on the initial presentation."

And if, furthermore, the primary function is excessive, then there ensues:

> "a facilitated course of the associative processes, a richness of presentations, a volubility . . . a flattening and eventually broadening of consciousness."

In 1906 Heymans and Wiersma joined these primary and secondary functions of Gross with the action and emotion of Ribot, to constitute a system of extreme comprehensiveness; one, moreover, that was based on extensive statistics, and even some experimental research.

To conclude this account of individual psychology based on generalized quantities of intensity and speed, we may say that to some extent it fits well enough with what McDougall has opposed to "temperament" under the new name of "temper".

§ 10. *A Vital Flaw*

At this point let us pause to consider how far we have really progressed. It would appear that a very considerable part of individual psychology has been, and still is, founded on the ancient theory of Faculties or Capacities.

But now we must recall to mind that the faculties have been submitted to repeated and scathing criticisms (Chapter XI). In what manner and to what extent have they in modern times been reformed?

Typical of the current answers to this question is the

plea that the modern view no longer disrupts the essential unity of the mind. Klemm writes:

> "Divided sorts of activities are, therefore, no longer to be looked for; instead, the unitary mental activity displays various sides. Here (in this unitariness) seems to lie the main difference of a classification in the modern sense from the old viewpoint of the faculty psychology."

But in truth, as we saw, the charge against the old-time faculties of denying mental unity was really baseless. And the same can be said of many other charges commonly urged against them. An outstanding instance is the allegation that they were formerly regarded as real and even substantial entities. Other attempted reproaches have had at most philosophical, not psychological, significance. Here comes the accusation made against faculties, that they pretend, but really fail, to "explain" matters. Yet other hostile comments proved to have their shafts really directed, not against faculties in general, but only against special cases of them. This includes the fault of being equivocal, which is pushed to a grotesque degree in the case of "intelligence", whereas many other faculties are in this respect almost blameless.

Over and above all such unsubstantiated charges against the faculty doctrine, however, there still remained two indictments which are very grave indeed. These were brought to their most acute expression by Herbart. One, indeed, does not here directly concern us; it is the case where training in any one kind of manifestation of a faculty is without evidence assumed to extend to all other kinds; for instance, exercise in poetic imagination was believed to improve geometric imagination. This case has been already treated in Part D. But there remains the second case impeached by Herbart. This was the further assumption that the presence of any one kind of ability belonging to a faculty indicates the presence of all other kinds; for instance, memory for

technical expressions is assumed to be correlated with memory for the novelties of the town. Such a generality, said Herbart, has never been demonstrated.

And *this* impeachment, unfortunately, seems just as applicable to-day as ever. The authors who lightly invoke various intellectual faculties—such as the "logical", the "intuitive", the "verbal", and so forth—produce no evidence that each or any of these alleged characteristics of an individual really functions as one single characteristic. The same may be said about all the other advocated faculties, as attention, memory, or imagination. Nor is the case essentially otherwise, on turning from cognition to volition. When, for instance, Bentham takes as his first Spring of Action that of the "Palate", may not the cases brought under this characteristic be split up, so that an individual may have pressing appetite for brandy and yet be temperate with ice-cream? Again, may not the cases included in the concept of emotionality admit of similar disconnection, in that a person who tends to suffer excess of grief may have no corresponding abundance of joy?

Nor can for a moment be admitted the often raised plea that the emotionality or other trait is dependent on particular conditions, so that the disconnection can only be understood in the light of the person's "total make-up". The more the trait depends on any particular condition at all, so inevitably the less valid is any estimate or measurement of the *trait in general*; it can only hold of the trait as restricted by the said conditions. And then these require to be definitely specified.

So much for the faculties or capacities with which this chapter commenced. But what about the other alleged individual characteristics to which we then turned? Take the temperaments. Cannot the same person be "sanguine" in some circumstances, but "melancholic" in others? Cannot some of a person's

ideas perseverate, but not others; some have prolonged secondary functions, but others short ones?

Now, if the reply to such questions be in the affirmative and to the effect that the items included in an individual characteristic always vary together, then there is at once the seemingly unanswerable question: Where is the evidence?

But if, on the contrary, the characteristic does comprise cases that are more or less independent of one another, then does not such a split-up characteristic fail to accomplish the prime scientific mission of indicating coexistence?

§ 11. *Upshot*

So far as it goes, the present chapter has given ground for anxiety. The characteristics which had been advocated for the purpose of differentiating individuals have proved to consist largely in revivals of the old "faculties", and in particular to share the one great defect of these; they have assumed that community of title involved concurrence in function.

We went on to examine proposed differentiating characteristics of two further kinds. One consisted in the well-known "temperaments". The other embraced all general mental quantities, these being: intensity, clearness, speed, with their combinations. But all these proved to suffer from just the same fatal malady as the faculties themselves. They all involved the unwarranted assumption that bearing the same name involves going together in actual fact.

CHAPTER XXXVIII

THE NEW TYPOLOGY

§ 1. Concept of " Type ". § 2. Types, Literary and Philosophical. § 3. Subjective and Objective Individuals. § 4. " Deep-Narrow " and " Shallow-Broad ". § 5. Introverts and Extroverts. § 6. " Schizothymes " and " Cyclothymes ". § 7. " Tetanoids " and " Basedoids ". § 8. Roseate Outlook. § 9. Misgivings. § 10. Upshot.

§ 1. *Concept of "Type"*

There remains, however, yet one more great line of systematic approach to individual psychology, besides those of faculties, capacities, temperaments, and even general quantities. This is just the one, moreover, which at the present day has excited the most enthusiastic following of all ; it is the approach by way of what have been designated as " types ". What precisely these are, however, and how in particular they differ from the faculties, capacities, temperaments, and so forth, about this there seems to reign still much obscurity.

At the start, it would seem, the term was mostly employed in physiological biology, and especially by French authors. Indeed, this usage is still predominant, as exemplified by the outstanding work of the physiologist Laugier on "*biotypologie*". In psychological literature, too, the earliest usage of the term would seem to have been that of French writers near the end of the nineteenth century with reference to the respective senses. One individual was said to belong to the " visual type ", another to the " auditory type ", and so on. Similarly,

Charcot and Binet in 1893 wrote a common article entitled " A Calculator of the Visual Type ".

But afterwards, as we have seen, each sense was also taken to constitute a separate faculty or capacity. Moreover, many authors began to extend the name of " type " to the temperaments also. In this way, there arose and still continues much obscurity as to what the term is really intended to mean.

There are indeed several typologists who undertake to supply a definition.

But even these writers, unfortunately, fail to show any tolerable agreement. For instance, Stern tells us that types differ from other class-characteristics by being less perfectly distinguished. Geyser possibly means much the same thing when he says that the term type should be applied when a large group of individuals suffer from some defectiveness of mental development.

But very different is the version given of types by Klüver, who says that they consist in " dynamic systems ", whereby some otherwise disconnected bits of behaviour are brought into more or less intelligible relation.

Widely unlike again is the view of Helwig. All problems of character, he says, " centre on the central problem: the concept of the type ". This concept he identifies with that of an " experience-quality " (*Erlebnisqualität*). " It lies in between the Object and the Subject " ; as example, he quotes the case where we say that " a forest gives the impression of sadness " (*wirke traurig*). He elucidates the matter by declaring that :

> " all experience-qualities are types. And all types are experience-qualities."

To make the situation still clearer, he adds :

> " type-predicates designate the mode of appearance of things as refracted in our experience."

Descending, however, from these metaphysical heights to the humdrum of plain historical fact, we note that " type " (τύπος), originally an impress or stamp, was applied by the ancient Greeks to the first clay model made by statuaries. Thence it came to mean the model, pattern, or exemplar of anything. That which was more or less perfectly copied from the model was called the " ectype ", whereas, for contrast, the model itself was the " prototype " or even " archetype ".

From this origin, we find by the dictionary that the term came in time to denote with writers in general :

> " The general form, structure, or character distinguishing a particular kind, group, or class of beings or objects."

But there seems to have arisen a tendency to impose upon this general usage of the term an important restriction ; to exclude from it the cases that are simple, retaining only the complex. The zoologist, for instance, would not talk of the " horned " type of sheep, although he would freely say the " black-faced " type ; the reason being that the possession or not of horns is a comparatively simple matter, whereas the blackness of face involves an elaborate system of attributes. Another common restriction of the concept is to confine it (with Stern) to cases marred by many exceptions ; that is to say, where not all, but only some, of the constituent characteristics are usually found in each individual. For example, albinism is generally admitted to constitute a type, whereas sex is not so named. A kindred usual restriction is to confine it to ideal cases that in actual experience are imperfectly realized. And, indeed, some such qualifications to the concept of a type would appear to be indispensable, at any rate in individual psychology. For in default of them, there would be a separate type for every mental process whatever ; one for each distinguishable variety of knowing, each act of willing, and each state of

feeling. The term would thus forfeit all scientific usefulness.

After this fashion, we seem to have reached a concept that expresses as well as may be the essential principle of the modern psychological school of typologists. It would seem to overlap somewhat with the older faculties, capacities, temperaments, and especially the "general quantities" considered already (Chapters X and XXXVII). On the other hand, it undoubtedly takes in a great more than can be appropriately called by any of these names.

§ 2. *Types, Literary and Philosophical*

On adopting this restricted meaning of the term "type", we still find its exponents falling into two broad categories: on the one hand, those whose interests tend to be literary or philosophical; on the other, those whose bent is more scientific.

Types of the former class are especially hard to distinguish from the old faculties, capacities, and temperaments. Instances already considered by us as faculties (Chapter XX) are those of Dilthey and Spranger. To these may be added Klages.

The first named sets out from the theorem that psychology is of two opposite kinds which are respectively "describing" and "explaining". The former is defined as:

> "the representation of the constituents and connections that uniformly occur in every developed human life, as this is bound together in a single system; that is not added in thought or inferred, but experienced. In the works of poets, in reflections on life as these have been expressed by great authors; in these lies a comprehension of Man in his entire reality. All explaining psychology remains far behind it."

Now this doctrine has doubtless had immense influence in Germany, but seems to attract less following in common sense. Truly enough, there can be a description devoid of explanation; although the "great authors" might not care to think that this is all that they can supply. But at any rate there cannot be any explaining without first describing what has to be explained. There is not even any obvious reason for representing description and explanation as mutually exclusive alternatives at all. Does not, in point of fact, the former supply the material which the latter then elaborates?

However, the mantle of Dilthey has fallen upon Spranger, who is engaged in patching it up. What the latter exalts above the "explaining" psychology is no longer the "describing" but the "understanding" kind. The latter he defines as follows:

> "The very complex theoretical act by which we apprehend the inward meaningful connection in the existence and action, the experience and conduct, of a man or group of men."
>
> "I call a functional connection 'meaningful' when all the partial processes contained in it can be understood from their relation to total-processes that have value."

His objects of value are, as already mentioned (Chapter XX), knowledge, utility, art, sympathy, power, and religion. Predominant desire for any of these is taken to constitute a "type".

But here again are serious difficulties, at any rate for the plain man. "Value" is commonly defined (as by Eisler) to be that which:

> "Seems desirable on account of being serviceable for a purposive will."

Accordingly, Spranger's doctrine would seem to imply, strangely enough, that a person's purpose must be taken into account in order to "understand" why he does anything, but not to "explain" why he does it.

Otherwise, however, the types appear to be straightforward enough. The predominant desire for each of the six objects is taken by him to constitute a separate individual " type ".

Passing on to his contemporary Klages, here we encounter a doctrine similar in general spirit, though divergent in detail. We now meet a " system of driving forces ", which are respectively " spiritual ", " personal ", and " sensuous ". These three, as mentioned previously (Chapter X), are then endlessly divided and subdivided. And to each of these " forces " and sub-forces a corresponding " type " is credited.

§ 3. *Subjective and Objective Individuals*

From all such types of predominantly philosophical interest, let us turn to those whose aim has been more strictly scientific. One of the first of these in modern times would appear to have been derived from some experiments of Binet on individual differences in describing pictures and in reasoning (1897–1904), followed by the work of Stern on testimony. The result was to indicate two opposite types called respectively " subjective " and " objective ". The former individual is revealed in :

> " the tendency of his description (of pictures) to give above all things himself, to bring to expression his personal relations to the things, his temperamental, volitional, and imaginative reactions to them."

Characteristic of the contrary or objective type of persons is :

> " the tendency of their descriptions to have a cool matter-of-fact (*sächlich*) nature, to seek to be just to the object as such."

Notable among later workers on this matter have been Baerwald, Kurella, and Partridge.

§ 4. "*Deep-Narrow*" *and* "*Shallow-Broad*"

Just about the same time, however, there appeared the already mentioned work of Gross on the quantities of the "primary" and "secondary" functions; these being respectively the initial and the ensuing effects of sensory stimulation. But Gross had another string to his bow. In addition to these general quantitative principles, he had his clinical experiences; these were in particular those two common insanities, melancholia and mania. These supplied him, as it were, with "prototypes" of the two characters which he calls respectively "deep-narrow" and "shallow-broad". In either case, ordinary people play the part of "ectypes".

Characteristic of the deep-narrow type were said to be:

> "difficulty in apprehending and elaborating outer stimuli, especially if numerous and disparate; embarrassment and unpracticalness: dissolution of the spiritual personality into single large systems of ideas which each in itself is closely connected, highly developed, and deeply rooted, but which are defectively associated between each other; long lasting emotions; tendency to exaggerate feeling-toned ideas; emotional irrationality."

Whereas the shallow-broad type is:

> "manifested in a prompt apprehension and instant utilization of outer impressions; presence of mind, cunning, and courage. But defective power to build up large systems of ideas, especially in ethical and social respects; inability to be profound; strong unstable emotions; levelling of feeling-toned ideas; emotional irrationality."

Now, his two functions and his two types he neatly fits together. Thus, the individual whose thoughts are apt to stray from the initial stimulus is identified with him "whose spiritual personality dissolves into single large systems of ideas". Whereas the person who does

adhere to his original point is taken to be " defective in ethical and social respects ".

§ 5. *Introverts and Extroverts*

Some twenty years later, there arrived on the scene another pair of " types ", which have attained to far greater renown. The Swiss psychiatrist Jung, acknowledging some inspiration from the English writer Jordan, declared that a person is either " introvert " or " extrovert ".

Here are a few items from the syndrome that is said to constitute the introversion :

> " Intensity is his aim, not extensity. . . . In thinking out his problems to the utmost of his ability, he also complicates them, and constantly becomes entangled in every possible scruple. . . . The subject perceives the same things as everybody else, only he never stops at the purely objective effect, but concerns himself with the subjective perception released by the objective stimulus. . . . The peculiar nature of introverted intuition, when given the priority, also produces a peculiar type of man, viz. the mystical dreamer and seer on the one hand, or the fantastical crank and artist on the other."

As for the extroversion, this

> " means an outward turning of the *libido*. With this concept I mean a manifest relatedness of subject to object in the sense of a positive movement of subjective interest towards the object. So far as the practical thinking of the merchant, the engineer, or the natural science pioneer is concerned, the objective interest is at once manifest. Feeling in the extroverted attitude is orientated by objective data, i.e. the object is the indispensable determinant of the kind of feeling. It agrees with objective values. . . . This kind of feeling is very largely responsible for the fact that so many people flock to the theatre, to concerts, or to church, and what is more, with correctly adjusted positive feelings. His aim is concrete enjoyment,

> and his morality is similarly orientated. His intuition is employed ' in the service of action and accomplishment ' rather than ' in the service of cognition and inner perception.' "

These two syndromes (that is to say, groups of symptoms) "coincide substantially", he admits, with those of Gross. But he rejects the latter's alleged secondary function, and attributes both the types to variations in the general tension of the primary function. He introduces, however, yet another interpretation ; he takes the terms intro- and extroversion to indicate that a person's mental energy (*libido*) may alternatively be directed either inwards or outwards.

§ 6. *"Schizothymes" and "Cyclothymes"*

Hard on the finding of these types in Switzerland by Jung, followed the advancing of another two in Germany by Kretschmer. And the latter pair—in the land of its birth, at any rate—has achieved even greater success.

Again, as by Gross, the two types are adopted from the two well-known insanities. But this time—unexpectedly enough—these latter are quite changed. With Gross they consisted of melancholia and mania. But with Kretschmer they become, on the one hand "*dementia praecox*", and on the other hand melancholia and mania combined.

Another change is that this time the types of mind are furthermore based on those of the body. But the fit is not too good. For whereas the mental types are only two in number, "schizoid" and "cycloid" respectively, the bodily types are three, "asthenic", "athletic", and "pyknic".

The mental types themselves are depicted with a luxuriance of imagination that rivals or surpasses even those of Gross and Jung. In a dry catalogue of the

schizoid peculiarities of character, indeed, these "arranged according to their statistical frequencies" are moderate enough:

"1. Unsociable, quiet, reserved, serious (humourless), eccentric.
2. Timid, shy, with fine feelings, sensitive, nervous, excitable, fond of nature and books.
3. Pliable, kindly, honest, indifferent, dull-witted, silent."

But as first concrete example of this type Kretschmer goes off the deep end:

> "A shy girl, pious and lamblike, serves for months in the town: she is gentle and tractable with everyone. One morning the three children of the house lie murdered. The house is in flames. She has not lost her senses, she understands everything. She smiles uncertainly when she realises her act."

With regard to the cycloid characteristics, the following are specified as the most frequent and always recurring:

"1. Sociable, good-natured, friendly, genial;
2. Cheerful, humorous, jolly, hasty;
3. Quiet, calm, easily depressed, soft-hearted."

As a concrete example, Kretschmer cites what he optimistically calls in general a "quiet contented type". It is a retired tax-collector, Wurzner, who

> "spent the middle years of his life in an almost ceaseless alternation of manic and depressive moods, which occasionally reached a psychotic state.
>
> "When he was 45 years old, Wurzner had to give himself up to rest, because he could not get on any more at the office. He was at this time like 'a wild bull, before whom someone waves a red cloth.' He would suddenly become quite enraged. Later on he was repeatedly plunged into melancholy, and in the meantime he spent day and night writing a seven volumed rhymed epic about the Seven Years' War."

§ 7. *"Tetanoids" and "Basedoids"*

Yet one more original typologist has obtained a wide and enthusiastic following. It is Jaensch. He too, like Gross and Kretschmer, sets out from a pair of insanities. But this time they lose all connection with any of those advocated previously. On the one hand, we now have the "tetany" condition; on the other, the disease of Basedow.

Here again, too, a connection is sought with conditions of the body. But this time recourse is had not so much to anatomy as rather to physiology.

In the first or tetany type, there is:

> "a heightened sensitivity of the optic sensorial nerves and their nearest connections in the central organ. Entirely corresponding to this we find an increase in the sensitivity of motor nerves to electrical and mechanical stimulation (the so-called Erbs phenomenon, *facialis* phenomenon of various degrees, etc.) as well as a lowering of the different sensory and sensible thresholds to the same stimuli. . . . Their eyes are small, deep-set, comparatively lifeless, without lustre, with no 'soulful' expression."

In the Basedow type, on the contrary:

> "Apart from the moist, luminous eye, there is a large number of other symptoms pointing to heightened vegetative sensitivity, particularly to mental stimuli. Vasomotor processes and the pulse are easily affected, especially by mental, but also by bodily conditions; arhythmic respiration, that is, changes in the frequency of the pulse during breathing, strong tendency to perspire, etc., are common. Individuals of this type are predominantly gracefully built, and have a soft, satin or silky skin with a low resistance to electric currents."

On the mental side, the start was taken from the extremely vivid images, called "eidetic", that are commonly found with children about 10-12 years old.

With some of the children, those that belong to the "T-type", the images were found to be extremely rigid.

> "Changes in them can only be carried out more or less slowly and sometimes not without effort, by re-forming, transposing, or rekneading the colour material. . . . They are felt as foreign bodies in the mental life, as something alien to the personality, and sometimes as positive hindrances."

But with other children, who belong to the "B-type", the eidetic images were

> "flexible and changeable . . . willingly and smoothly following every change in the flow of ideas."

Now, where these two totally different types of image occur, Jaensch says, then:

> "We are also dealing with totally different types of mind. The mental organism of individuals with the rigid images is in extreme cases fitted together out of pieces, as it were, like a machine; the individuals with the labile images stand closer to memory images, in pronounced cases present an organic unity in which the component parts are from the start in closest connection and interaction. In this type the mental functions *interpenetrate*, as it were; in the other they behave as though dissociated from one another. E.g., corresponding to the images that force themselves on the observer's notice, and persist even against his will, there can be ideas that seem no less alien to the personality and are felt as foreign bodies like the images."

However, this the original eidetic typology would appear to have undergone much subsequent modification, whereby amends have been made for its initial comparative lack of definite psychological content. The disintegrated "T-type" is turned into the "S-type", a characteristic tendency to mental dissolution (*Auflösung*) and eventually decomposition (*Zersetzung*). In this state the mind is "autistic" and self-centred. It suffers

from anxiety and, at the limit, from the schizoid insanity. What was formerly the " B-type " now becomes the " J-type ", wherein all the preceding S traits are reversed.

But this time the differentiations are rendered finer. The S breaks up into S_1, S_2, and D. The S_1 mind is soft, malleable, loose in structure, and unreliable; to this sub-type are assigned the Celtic races; also political liberals. At the next stage, S_2, the mind is characterized by becoming " rational in its upper part " (*Oberbau*). This sub-type is exemplified, rather unexpectedly, by those Nazis who out-Herod Herod, are *plus royalist que le roi*, or " Nazis 150 per cent ". As last part played in this strange eventful history comes the sub-type D, or final disintegration.

The J's analogously split up into J_1, J_2, and J_3. Persons belonging to J_1 are:

> " unconditionally integrated with the outer world."

Among their ranks are placed the South Germans and the Italians. The J_2's are only integrated with the outer world *conditionally*; they have high ideals. The J_3's for their part are integrated *inwards*. They include the North Germans and the English.

§ 8. *Roseate Outlook*

Truly, all these are very wonderful pictures that have unrolled themselves before our eyes. Well founded, then, seems to be the claim of Helwig that:

> " A fullness of form-qualities of character, which would otherwise fall apart, show themselves today, under more comprehensive points of view, as *Unities*."

Furthermore, there seems to be a growing tendency to believe that all these variously designated pairs of types are really converging on one and the same central type and anti-type. Ach goes so far as to treat each of

the great pairs, tetanoid — basedoid, schizo-thyme—cyclo-thyme, introvert—extrovert, secondary function—primary function, and even perseverator—associater, as being substantially identical.

Of still more wonderful promise is the report of those typologists that they have discovered means to establish and even to measure these types by extremely simple mental tests. Indeed, for the most part they have not even found any need to invent these specially; they could pick out what they wanted from such familiar little experiments as those of determining how many marbles can be perceived at the same time or how many objects can be seen in an ink-blot.

§ 9. *Misgivings*

Unfortunately, however, the situation is not without certain less favourable aspects. To begin with, such descriptions of types are really no new thing. On the contrary, they go back right throughout historical record. Over two hundred years ago, Earle gave quite as comprehensive pictures. For instance, there is his elaborate account of the " stayed man ", which begins as follows :

> " Is a Man. One that has taken order with himself, and set a rule to those lawlessnesses within him. Whose life is distinct and in method, and his actions as it were cast up before. Not loosed into the world's vanities, but gathered up and contracted in his station. Not scattered into many pieces of businesses, but that one course he takes, goes through with. A man firm and standing in his purposes, not heaved off with each wind and passion. . . ."

Or again, there is his no less minute description of the " bold forward man ", which begins :

> " Is a lusty fellow in a crowd, that's beholden more to his elbow than his legs, for he does not go but thrusts well. He is a good shuffler in the world, wherein he is so off putting forth, that at length he puts on. . . ."

Two thousand years still earlier, such pictures were being plentifully supplied by Theophrastus. But almost all this fluent and even eloquent description has now passed into oblivion. In literature it has indeed made its mark. For sober science, it seems to have achieved little or nothing.

One would like to think that the modern typology is going to be preserved from such an eventual fate by its superior merits. But even in this respect, a closer scrutiny seems to afford scanty comfort. Thus Helwig writes of Jung's types as follows:

> "What can this opposition between extrovision and introvision be supposed to mean? It is so void and vague, that all contraries can find a place in it. . . . Jung contents himself with pictures upon pictures, and loses himself in such associative progression from picture-resemblance to picture-resemblance, that hardly one of the problems at issue is really grasped."

And some critics are inclined to charge no less "voidness and vagueness" against the other modern types (more so, indeed, than against the old ones). Almost all of them excite in the plain man a suspicion of being built up, not by genuine observations, but by extraordinarily far-fetched analogies.

Again, these types may be hard pushed to clear themselves of grave inconsistencies. Their alleged correspondence with anatomy, with physiology, and even with elementary tests of ability are difficult to reconcile with the repeated observation, as by Mall, that these types are very unstable. Again, the attempt to connect the types with tests is almost exclusively done by means of questionnaires in which—as the typologist, Bayer, himself admits—every subject shows some of his traits to be schizothyme and some cyclothyme, so that:

> "a numerical union of the results is out of the question."

Yet again, how can we accept the asserted identity of the

different type-pairs with one another, when we remember that their respective prototypes consist in quite different insanities?

To all these seething troubles of the modern typology there is still another to be added, and the worst of all. In the preceding chapter, we found that all other attempts to characterize general individual differences—by faculties, temperaments, and so forth—had tripped over one and the same fatal stumbling-block. This was the unsupported assumption that mental processes which come under the same denomination go together in actual function. Now, in the present case of types, the proof of what goes together is not less but more needful and difficult. At best, as we have seen, all types consist of complex structures which are more or less masked by irregularities. And with the types at issue here, such masking influences surely must reach their highest degree.

Everything would seem to depend, then, on the manner in which the typologists meet their great task of discovering correlation in spite of great masking irregularities. And one cannot but be dismayed to find that almost everywhere the method adopted is that of general impression. Throughout, we are reminded of the scathing criticism of Claud Bernard:

> "When one begins to base opinion upon feeling, upon inspiration, or upon a more or less vague intuition about things, one is outside of science."

And in the rarer instances where our typologists do try to eke out their "inspiration" by any method of definite statistics, this tends to be surprisingly amateurish. In general, the evidence proffered by them can be charged with being inadequate; often, worse still, it seems too good to be true.

In fact, they do not even display much interest in the matter. Jung, for example, at one time set up only two

types, introvert and extrovert; but at another time he requires a separate pair of such types for each of his four mental faculties: sensation, thought, feeling, and intuition. Whichever of his two typological doctrines is right, the other must be quite wrong. But neither he nor anyone else, apparently, ever tries to obtain definite evidence. Similarly, as we saw, Jaensch, starting out with only two types B and T, arrived eventually at S_1, S_2, D_1, J_1, J_2, and J_3. If either of these schemes really present functional unities, the other certainly does not. But about this nobody worries.

On the whole, no doubt, some of all the typological shots may eventually show themselves to have hit the mark. But at present, there is no means of deciding *which*.

§ 10. *Upshot*

The course of events narrated in this chapter has been exciting. One exultant "type" after another has passed before us in thrilling cavalcade. Psychology has seemed to rise to heights not hitherto touched in dreams.

But with reflection there arrived a change of spirit. Other such types, it was noticed, have come and gone since the earliest times without leaving a trace behind them. And those that are showing so bravely at the present day reveal on close scrutiny no better foundations.

Above all, these "types"—as previously, the faculties, temperaments, and so forth—have failed to supply just what constitutes an irreducible minimum for science in general—namely, a proven account of *what goes with what*.

CHAPTER XXXIX

CORRELATION COEFFICIENTS

§ 1. Invention of Coefficients. § 2. Reactionary Psychologists. § 3. Computation versus Interpretation. § 4. The Reconciliation. § 5. Plethora of Figures. § 6. Upshot.

§ 1. *Invention of Coefficients*

In this scientific crisis the remedy might seem to be obvious enough. Since the difficulty lies in not knowing whether and when different activities vary together from individual to individual, why not simply look and see? And indeed for extreme cases, those where the concomitant variation is approximately perfect, this procedure seems to be all that we require. But in general the situation has been depicted as follows:

> " All knowledge—beyond that of bare isolated occurrence—deals with uniformities. Of the latter, some few have a claim to be considered absolute, such as mathematical implications and mechanical laws. But the vast majority are only *partial*; medicine does not teach that smallpox is inevitably escaped by vaccination, but that it is so generally; biology has not shown that all animals require organic food, but that nearly all do so; in daily life, a dark sky is no proof that it will rain, but merely a warning; even in morality, the sole categorical imperative alleged by Kant was the sinfulness of telling a lie, and few thinkers since have admitted so much as this to be valid universally. In psychology, more perhaps than in any other science, it is hard to find absolutely inflexible coincidences; occasionally, indeed, there appear uniformities sufficiently regular to be practically treated as laws, but

infinitely the greater part of the observations hitherto recorded concern only more or less pronounced *tendencies* of one event or attribute to accompany another."

At the period when these words were used by the present writer nearly a quarter of a century ago, need was found to add the following comment:

> "Under these circumstances, one might well have expected that the evidential evaluation and precise mensuration of tendencies had long been the subject of exhaustive investigation and now formed one of the earliest sections in a beginner's psychological course. Instead we find only a general naïve ignorance that there is anything about it requiring to be learnt. One after another, laborious series of experiments are executed and published with the purpose of demonstrating some connection between two events, wherein the otherwise learned psychologist reveals that his art of proving and measuring correspondence has not advanced beyond that of lay persons. The consequence has been that the significance of the experiments is not at all rightly understood, nor have any definite facts been elicited that may be either confirmed or refuted."

The remedy devised for this unhappy state of affairs was at that time described as follows:

> "The most fundamental requisite is to be able to measure our observed correspondence by a plain *numerical symbol*. There is no reason whatever to be satisfied either with vague generalities such as 'large,' 'medium,' 'small' or, on the other hand, with complicated tables and compilations.
>
> "The first person to see the possibility of this immense advance seems to have been *Galton*, who, in 1886, writes: 'The length of the arm is said to be correlated with that of the leg, because a person with a long arm has usually a long leg and conversely.' He then proceeds to devise the required symbol in such a way that it conveniently ranges from 1 for perfect correspondence, to 0 for entire independence, and on again to -1 for perfect correspondence inversely. By this means, correlations became com-

parable with other ones found either in different objects or by different observers; they were at last capable of leading to further conclusions, speculative and practical; in a word, they now assumed a scientific character."

In due course, this system of measuring concomitance was immensely developed. Many new coefficients were introduced, such as those of so-called "association", "colligation", "contingency", and in particular "product moment". Much, too, has from the beginning been written about the significance of these respectively. And, beyond a doubt, each of them can be regarded from a variety of angles. For the present, we are interested in their common significance as measuring degrees of tendency to concomitance.

Further development of these correlation coefficients has consisted mainly in devising methods of determining, and if need be eliminating, three disturbing influences. One is the so-called "sampling error" which derives from considering too few cases. The second is the "attenuation" resulting from the random errors made in measuring each case. And the third is the "distortion" introduced by admission of irrelevant systematic influences; a common instance is that of letting the sample under consideration consist of persons of very unequal ages. The whole treatment has been enormously developed under the designations of "multiple" and "partial" correlation. By means of these, the application of the coefficients can be extended to any number of variables, mental or otherwise.

The results obtained by this new scientific tool were, on the whole, disconcertingly adverse. The supposed generality was seldom if ever corroborated. Nowhere did the correlations prove to be anything like perfect. Often they were but little above zero. And these unhappy cases included some where the correlations had before been so confidently assumed that the gravest

action had been taken upon it. An instance that would have been comic, had it not been tragic, was where a great nation, which was at war and urgently needed men to fly, rejected 20 per cent of its candidates on the ground that tests showed them to have slow reaction. In truth, exact investigation had already shown that success at such tests and at flying did *not* appreciably correlate with one another.

§ 2. *Reactionary Psychologists*

Sad to say, however, the new statistical treatment of correlation has brought into individual psychology not peace but more war. Having originated in England and quickly spread over to America, it developed and greatly flourished in both those regions. But on the continent of Europe, and especially in the German-writing countries, it excited nothing but hostility.

For this refractoriness there were several reasons. In the first place, the innovation, indicating as it did that most of the study done so far had been fundamentally erroneous, could not fail to evoke deep antagonism. In the second place, Germany has altogether not been very accessible to scientific influence from outside. Some idea of the strength of the existing international barriers can be gathered from a comparison between two recent published bibliographies on the present topic. The American author quotes 271 works in English and 2 in German. The German author quotes 25 in German and only 2 in English. This attitude finds perhaps its most naïve expression in the recent work of Helwig, which bears the general title of "characterology", but actually is limited—as the author expressly tells us—to the study done in his own country, since this, he says,

> "has quite definitely taken over the lead in characterology."

Besides, most German psychologists have been so pre-occupied with exalting "wholes" and depreciating "sums", that in their works most other considerations would seem to have been crowded out. Stern, for instance, has recently presented to us the following conclusion:

> "A single empirically discovered character trait requires a threefold examination: as to its intrinsic nature, as to its inter-individual comparability, and as to its personal accent or significance."

As for examining the trait in the supreme respect of generality, this neither here nor elsewhere seems to be mentioned by him.

For a long time, the opponents of the correlational movement took up the formidable defensive line of ignoring it; waiting, perhaps, until it should of itself die down. "Their strength was to sit still." But recently stung, perhaps, by the increasing gibes of the correlationists, they have begun to answer back. However, their efforts in this direction have been, to speak frankly, disappointing. One author attacks the whole of statistics, root and branch; he takes its methods to be "Aristotelian" and identifies averages with "mediaeval essences". Any reputable book on the subject, Yule's for instance, would have told him differently:

> "By statistics we mean quantitative data affected to a marked extent by a multiplicity of causes.
>
> "By statistical methods we mean methods specially adapted to the elucidation of quantitative data affected by a multiplicity of causes."

Other recalcitrant authors have specially attacked the statistical treatment of correlations. For one thing, they have charged it with being restricted to variation in "one dimension". They do this in face of the fact (already mentioned) that its earliest and most funda-

mental development was in this very respect of multiple dimensions.

Less wide of the mark, at any rate, is the reproach that the calculation of correlation is based on those arch offenders, "sums". For truly enough it does very frequently represent multiple causes by additive quantities. But, as we have seen (Chapter XXVII, § 3), the composition of causes in many cases really is of the additive kind. More important, however, is the fact that, even when the composition is of some non-additive kind, still the additive form presents in general *the best approximation* (by "Taylor's Theorem"). Anyway, the statistics of correlation, when pushed, can also deal with quantities that are not additive, but have instead any other functional relation. For instance, the present writer has himself worked out the theory of "Two Factors" on the basis of these being not additive but multiplicative.

In general, the opponents of the correlational statistics seem to have scant acquaintance with its technique and no idea of the extent of its resources. What is perhaps still worse, they eke out the supposed deficiencies of the standard procedures by others which they have not too happily devised themselves.

So far, the reactionary psychologist has attacked the correlationist in the latter's own territory, and so has been a fish out of water. But he has also made a stand on ground where he is more competent. For besides assaulting the statistical procedures themselves, he has furthermore strongly objected to the contents submitted to these. Such contents have been declared to consist only in "simple habits of behaviour"; in "sensations" and "images"; in "lower-level specific actions"; in "isolated traits"; in "scientific and objective descriptions"; or in "numerical ratings".

To replace all these things, the reactionary school

demands such characteristics as "general emotional traits", "conative drives", "dynamics", and "values". Moreover, it claims as a merit to derive its facts from "intuition" rather than that of measurement.

But these authors would appear to confuse the issues. The procedure and the content of research are two different things. Those who employ statistics may indeed apply these exclusively to uninteresting actions, but they certainly are not bound to do so. Let us look at the very earliest application of correlations to the study of personality; that is to say, the work of Webb. In this, such things as "sensations", "images", "simple habit", "isolated traits", or "lower-level specific actions", far from monopolizing the research, do not really appear at all. And as for the "general emotional traits", these do abound, both with Webb and in many researches since.

Nor is the usage of statistics even restricted to definite measurements and excluded from "intuitive" ratings. Assuredly it was no yardstick with which Webb managed to bring within his scope such traits as selfishness or conscientiousness. As for the reproach of not taking into account the intuitive clinical reports, anyone uttering it leaves out of account the work of T. V. Moore, not to mention that of Stephenson, Simmins, Studman, and others. The truth is that the fundamental objection raised by the new school to the old intuitive procedure has been limited to one particular case, the estimating of correlation. For in this case, however it may have been in others, experience has shown unaided intuition to be extremely fallible. Such, then, is the essential characteristic of the new statistical school—to estimate the degree that two (or more) events tend to correlate. This estimation, it contends, is in need of coefficients. Moreover, it no less urgently requires a mastery of the technique by which these coefficients should be applied

and handled. Those, on the other hand, who oppose this statistical treatment are declared to be not reformers but only reactionaries. They are said to plunge us back again into the old, old faculty-psychology.

§ 3. *Computation versus Interpretation*

Have then these neo-facultists *no* right on their side? According to the present writer, at any rate, they have a great deal. Their psychology, especially in Germany, deals with mental relations of profoundest interest. Correlations, on the other hand, are silent about these; they express coexistence, but nothing else.

Few contrasts are more striking in individual psychology than when we pass from the arid deserts of unintelligible statistics to the tropical exuberance of their rivals. Not without good grounds do the latter claim for themselves the title of "describing" psychologists. Dramatic are the tales spun round the "life-forms" of Spranger, the "introverted libido" of Jung, the "T-Constitution" and "B-Constitution" of Jaensch. And even these can for wealth of detail and poignant interest scarcely match the "schizothymes" and the "cyclothymes", not to mention the "pyknics", the "dysplastics", and the "hypoplastics" of Kretschmer. Moreover, the work of the last named has been developed in a wonderful manner by his Marburg colleague, Kroh, to whose inspiration we owe a fascinating series of publications by Pfahler, Lutz, Bayer, Dambach, Vollmer, Dieter, P. Lamparter, and H. Lamparter.

However, even these latest-comers hardly surpass in wealth of detail and eloquence of exposition their predecessors of long ago. An outstanding instance is the grandiose individual psychology which Beneke built up on his three "ground-properties", which were: "excitability by stimulation", "power of assimilation",

"liveliness of mental operation". Nothing can be further from the truth than to suppose that descriptive psychology is, in principle, anything new. The fact is that this individual psychology unfettered by statistical quantities lends itself in extraordinary degree to "thick coming fancies". The trouble with it lies not in painting the pictures, but in ascertaining which, if any, of them correspond with the facts. Science cries out for truth; it does so above all things in respect of its irreducible minimum, sequence, and coexistence; we need to know, What goes with What. To obtain this knowledge, the procedure which is unaided by statistical devices can never be trusted.

§ 4. *The Reconciliation*

And so we seemingly arrive at a dilemma. The neo-facultists are building up their magnificent systems on extremely unreliable foundations. Many correlationists, inversely, are laying down solid foundations, but appear impotent to build upon them. How are these two procedures ever going to be converted from opposition to co-operation? In general, the answer is facile enough. The statistical computations have to be combed for regularities, uniformities, or laws; whilst the psychological imaginations have to be multiplied until they present adequate explanatory theories. In detailed application, indeed, the business becomes extremely complicated; usually there is a large choice of psychological theories to explain any observed set of correlational coefficients; conversely, any of these coefficients can be employed to check up and verify any psychological theories. Given the will to co-operate, however, progress might seem assured; the psychologists who imagine things but do not prove them have only to join hands with those who prove though they do not imagine.

§ 5. *Plethora of Figures*

However, the progress of science is like the climbing of a mountain; each peak surmounted reveals a higher one behind it. He who would bring psychological significance to his correlational coefficients is apt to be appalled by their infinite multitude and seemingly hopeless disorder. Copious data are accumulated by dint of unwearying observations; thence interminable calculations are effected by magical machinery. Averages are piled on averages, sigmas on sigmas. From the original coefficients are distilled partial ones to the *n*th order. Out of both kinds is derived an analogous array of regression equations. And so forth, without end. In what fashion shall all this plethora of computations and the aforesaid imaginativeness of theory ever be brought to terms with one another?

A further grave embarrassment derives from the fact that the correlations actually observed are very imperfect, taking all coefficient values down to zero. But science, on the contrary, deals with laws, where the correlations are approximately perfect. How shall we discover these perfect values by means of those which are imperfect?

§ 6. *Upshot*

We have seen that the critical need of individual no less than of general psychology is to ascertain how far different items of mental experience tend to go together, and in this fashion to constitute functional unities or generalities. This need we have found to have been met by the wonderful device of correlational coefficients.

Nevertheless, these have only been adopted by half of the psychological world. The other half has tenaciously clung to the venerable standpoint of faculty-psychology. Some authors have simply continued to

assume the generality without any warrant at all. Others accept it on the ground of what Bernard called "a more or less vague intuition about things". Yet others ran full tilt against current statistics in general, but without inspiring any confidence in their own knowledge of this subject.

Still, even if the two parties, imaginative and computative respectively, did bring themselves to co-operate, there would still remain a most formidable barrier to further progress. It is that both are so astoundingly prolific; fancies and figures alike are poured forth in bewildering disorderly multitude.

CHAPTER XL

DISCOVERY OF " G "

§ 1. The Problem. § 2. Observation of Hierarchy. § 3. Deduction of " G " and " S ". § 4. Uniqueness of " G ". § 5. A Large Experiment. § 6. Universality of " G ". § 7. Saturation with " G ". § 8. Nature of " G ". § 9. Controversy. § 10. Upshot.

§ 1. *The Problem*

At the stage depicted in the preceding chapter, the statistical situation had become precarious. The most fundamental necessity, indeed, had been supplied; this was a coefficient whereby the tendencies of any items to go together could be definitely measured. Moreover, such coefficients had been devised in great variety so as to suit the most diverse special cases. More still, there had been very elaborate extensions of technique in other directions; such as the inventions of " multiple correlations " and " regression equations ". Nevertheless, all this could not save the correlational method from three catastrophes. Firstly, the coefficients and so forth soon multiply beyond human power of comprehension, or even of computation. Secondly, the correlations so calculated almost always prove to be low; whereas, in order to express a genuine scientific law, the correlation must be approximately perfect. And thirdly, the figures so far attained did not express in a convincing manner any definite psychological significance.

On the psychological side, the situation was no less perplexing. Here, too, the main trouble was an embarrassment of riches. There was no deficiency of

doctrines, but an excess; the difficulty was to choose between them.

Accordingly, scientific development was faced by two main problems; that of winnowing out the true information from the false, and that of reducing chaotic complexity into intelligible simplicity. The difficulty of combining these two requirements together, and in particular the treacherousness of the quest of the simple, has been evident throughout psychological history.

Our account of what has been achieved will start from the domain of cognitive ability, since this has made much greater progress.

As regards the principal doctrines on whose claims there was greatest need of adjudication, three were outstanding. Oldest and still the most widely supported, or at least implied, was that which takes ability to be composed of a small number of "faculties" or "types". Much later had come on the scene the comparatively rare belief of Herbart and his school, that ability splits up into an indefinitely large number of independent elements, such as sensations or associations. The last of the three views to arrive was the one whose popularity now seems to be rivalling even that of the faculties; this takes mental ability to be one single thing, susceptible of one single measurement, under the name of "intelligence", or perhaps "general intelligence". These three rival doctrines have been named respectively: "oligarchic", "anarchic", and "monarchic".

§ 2. *Observation of Hierarchy*

Now, such problems as are here presented admit of solution in either of two ways. The argument may start from some hypothetical conception, and proceed to verify this in some regularly recurring observation. Thus, Robert Mayer set out from the belief that "nothing can

come out of nothing", and arrived at the confirmatory finding that, whenever 365 kilogramme-metres of work disappeared, then a pound of water became one degree hotter. The other kind of solution moves, on the contrary, from observation to hypothesis. An example is afforded by the physicists who, to begin with, noticed that rubbed amber always attracts shreds of paper, and from this basis proceeded to invent the explanatory concept of "electricity" (*electron, amber*).

Now, this latter direction of movement was the one taken, initially at any rate, by what is called the Theory of Two Factors. That is to say, the starting point consisted, not in any hypothesis, but in an observed regularity. As set forth by Darmois, the order of search was, firstly for statistical regularities, and then for their interpretation. A number of persons were submitted to a set of mental tests and assigned scores on their performances. All the intercorrelations of the tests were calculated. Thereupon was made a momentous observation. It was noticed that whenever the tests were sufficiently dissimilar, not otherwise, the coefficients admitted of arrangement in a peculiar orderly system, since called a "hierarchy". An example of ideal perfection in this respect is given in the following table, where the letters a, b, c, d stand for the tests (or other correlated items) whilst the decimal numbers are the correlation coefficients

	a	b	c	d
a		·9	·6	·3
b	·9		·4	·2
c	·6	·4		·1
d	·3	·2	·1	

Most obvious about this system of coefficients is the way that the values steadily diminish both from top to

bottom and from left to right. But other criteria of the hierarchy, especially such as do not depend on the order in which the tests happen to be arranged, have been considered more satisfactory for scientific purposes. And these criteria have actually, it is claimed, been satisfied to just the degree of approximation that was possible in view of the inevitable errors of experiment; on making due allowance for these, the agreement became almost perfect.

§ 3. *Deduction of "G" and "S"*

On the heels of this observation followed a no less basic mathematical deduction. The discovery was made that when, and only when, the said criterion of hierarchy is satisfied, then each of the test-scores (or other variables) can be divided into two independent parts or factors, the one general (denoted by G) and the other specific (denoted by S). More precisely, if A stands for the score made by any person at any particular test, there ensues the following fundamental equation:

$$A = G + S \quad . \quad . \quad . \quad . \qquad \text{(I)}$$

If we replace A by B or C, etc.—the scores of the *same* person at any *other* tests—then his G will retain every time the same proportions to those of all other persons, whereas his S will be randomly different. The proof of this surprising fact that the hierarchical arrangement leads to equation I is given elsewhere; it is purely mathematical.

However, there are a few points that have to be elucidated here to avoid serious misunderstanding. First of all, we must not forget the above-mentioned needful condition for I; namely, that the tests A, B, C, etc., should be "sufficiently dissimilar". In so far as this condition *fails*, the S's are *not* mutually independent, but on the contrary present some mutual "overlap". And

in this respect the S's have shown themselves to fall into two distinct classes. With those of the far commoner class, the range of overlap is very "narrow". With the S's of the rarer class, on the other hand, the range is "broad". In this way, the factors fall into *three* classes: G, whose range is general; the broad S's, whose range is far from general, but nevertheless considerable; and the narrow S's, whose range is very small indeed. And so, it will be observed, the results afford a certain amount of support to all three of the doctrines that have appeared in the chronicles of psychology: the monarchic, the oligarchic, and the anarchic. Still, as we shall see, the likeness is rather superficial.

Let us turn to another point of great importance, in order to avoid grave misunderstandings. It is that the fact of A being divisible into G and S does not prevent it from being divisible some other way instead. In general, any magnitude can be divided up in a million ways, although indeed there are billions and trillions of ways in which it can *not* be so. Thus 10 is always equal to 9+1, 8+2, etc.; whereas it is never possibly equal to 2+5 or to 12+17. Why, then, should any one mode of possible division be preferred to any other? The criterion lies in scientific fruitfulness. That particular division should be chosen which is most "parsimonious" of explanatory principles; cautious preference must be given to simplicity. And such appears to be the transcendent merit of I. In it, all the correlations between all the abilities are explained by one single factor, G. With any other division whatever, the correlations necessarily involve two or more factors.

The preference is, in fact, analogous to that which occurred when Copernicus and Kepler discarded the extremely complicated doctrine, that the planets move in epicyclical orbits; they found that the observations could equally well be met by the comparatively far simpler

conception of movement in elliptical orbits. The resemblance between the two cases has been penetratingly indicated by Thouless.

Yet another point whose better appreciation would have prevented much useless controversy is that different ways of dividing into factors are not necessarily antagonistic. They are so, indeed, in the case of physical separation; if a tree is chopped up into firewood, it cannot at the same time be sawn into planks. But mathematical factors, as given in I, are only manners of thinking, or angles of view. Any number of them may be true at the same time (as in the familiar case of algebraic "simultaneous equations"). Quite possibly, then, one division will serve one scientific purpose, another one serve another. Those which do not help science at all—though thereby none the less true—are what Holzinger has stigmatized as "arti-factors".

§ 4. *Uniqueness of "G"*

We pass, now, to a matter that is no less important and much more subtle. It is the question as to whether the G defined by I is "unique" or not. Assuming that for any given set of tests the criterion of "hierarchy" is satisfied, we can be certain that this G of any individual has always a possible value. The fear now is that it may be capable of assuming different values.

A suggestion had been advanced to this effect. There can be, it was said, not only more than one such value, but an infinite number of them. In fact, the suggestion continued, the G of any individual may be made to take any value at all, regardless of his actual ability. In this way a person who was at first represented as a genius may on recalculation be transformed into a moron, and vice versa. For the purpose of mental tests, the prospect was certainly disquieting.

The defence against this formidable attack has been along two lines. The first is that such transformations of value, though possible, are infinitely improbable.

The second and still stronger line of defence has been that all the possible different values of G for any individual converge on one and the same value in proportion as the number and validity of the tests employed grow larger and larger. If we conceive the final limiting value as the "true" one, then all other values can be regarded as consisting of this true value plus an error committed in measuring it. In this way, G only follows the lead of all scientific measurements whatsoever. Every one of them is regarded as the true value plus some error of measurement. This true value of G admits of perfectly definite formulation and approximate calculation; it *is* "unique".

Such has been in substance the eventual verdict of the mathematicians Piaggio and Irwin. The latter writes:

> "as the number of tests is increased indefinitely there is a vanishing degree of probability that the indeterminacy in any person's 'g' estimate will exceed any positive quantity however small."

The question just considered was as to whether the G of any individual remains always one and the same when calculated from any given (hierarchic) set of tests. But the further question has also arisen, as to whether this G still remains the same when passing from one set of tests to another set. To devise a criterion was a further task for mathematicians. It was first achieved by means of "reference values". Subsequently, however, a simpler, more effective, but more arduous plan was adopted. The multitudinous sets of tests, each set being of comparatively small scope and applied to a different group of persons, were replaced by a single set whose scope was made, so far as could be, universal. To this exhaustive set, as usually superseding all others, we

will here mainly confine ourselves. But the other work done in this sphere will not be left out of account.

On the whole, then, we have in the true G a value which satisfies the primary scientific requirement of being unique or, what comes to nearly the same thing, unequivocal. And in so being it escapes both the two fatal infirmities of the still commonly adopted "faculties". It does not, like "attention", throw together as constituting a single ability what in truth are a number of more or less weakly intercorrelated ones. Nor does it, like "intelligence", use a name which wanders so hopelessly from one meaning to another as finally to forfeit all meaning.

§ 5. *A Large Experiment*

From this outline of the development of the general theory, we will go on to cite some of the leading actual observations. And here, as said, we will chiefly consider the latest and much the most extensive investigation. This was conducted at Chicago under the auspices of an International Committee with Thorndike as Chairman. It contained no less than ninety-four different tests to which all the testees were submitted. In order to select these tests judiciously and impartially, an appeal was made to the leading psychologists in every country. They were requested to indicate what they took to be the chief human powers of knowledge. And all suggestions made by them were taken into full and sympathetic consideration (see Chapter XXXVII).

As finally organized, the ninety-four tests fell into two main categories, the one aiming more at theoretical analysis, whilst the other had more immediately practical ends in view.

In the former case, the research was naturally extended to all the four great ancient faculties: those of

sensory perception, thought, memory, and creative imagination (or "invention"). To these was added the hardly less ancient faculty of "attention".

As regards the perception, several tests were devoted to visual form—both the educing of relations and that of correlates—because of this having previously shown especial promise for measuring G. But further tests were devoted to other perceptual abilities; in particular, the discrimination of brightness and that of pitch.

As regards the faculty of thought, the tests of this too were so fashioned as to comprise the educing of both relations and correlates; the relations included in particular those of evidence and of likeness, besides those called "real".

The memory tests included those of pitch, of related and unrelated association, as well as of recognition immediate and delayed. The power to reproduce was tested in a variety of manners.

The tests of "free" imagination included the familiar ones of interpreting ink-blots, of completing forms, and of completing pictures. There were also tests of verbal fluency and of power to realize strange situations. There was a further test of "controlled" imagination.

Six other tests were intended to measure mental speed. They consisted in operations so easy that all subjects could perform them successfully, and therefore differed solely in their respective rates.

Another ten tests were of motor kind. For instance, one was of speed of tapping, another was of speed of writing S's, and yet another was the strength shown with a dynamometer.

The tests of "attention" were selected from among those which other authors had devised and recommended for measuring this capacity. Most of them consisted in working out brief problems "in one's head"; that is, without the aid of writing.

We pass on now to the second great category of the tests; namely, those whose immediate significance was practical rather than theoretical. Whereas the first category had aimed at laying down a scientific foundation, this second kind tried to build up a superstructure of application and verification.

To begin with, this superstructure had to include leading representatives of what is commonly regarded as science. For these the choice fell on the following three: arithmetic, geometry (pure), and mechanics. These were again subdivided; thus, arithmetic comprised both computation and problems; mechanics took in both comprehension and invention.

Additional to all this, and in some ways contrasting with it, was an array of tests dealing with linguistic talent. Primarily this was divided into comprehension and expression. The former was made to include various kinds of recognition (form, letters, and words), as also of understanding (words and paragraphs). The expression included choice of words, correctness of grammar, excellence of composition, soundness of generalization and power of abstraction.

Separate again both from the scientific and the linguistic abilities were taken to be the psychological kind. As representative of these the following powers were chosen: interpreting emotional expression; interpreting behaviour; and solving social problems.

Yet another domain considered was the power of aesthetic appreciation. Here, three special regions were selected for testing: musical, pictorial, and literary.

As final test, there was included one of the now familiar kind which bears the name of "general information".

The subjects submitted to all the foregoing tests consisted of 1100 children, 10-17 years of age.

Over and above all the preceding tests, which were

specially devised and executed for the present research, the children had already been much observed, and even tested, on earlier occasions. In particular, they had been submitted to three of the best known group tests of "intelligence": those of Otis, of Kuhlmann and Anderson, and of T. Morgan. Altogether, this whole Chicago survey of cognitive ability seems to have fairly fulfilled its mission of being as impartial and all-embracing as could reasonably be demanded.

§ 6. *Universality of "G"*

Passing from this all too slight description of the tests to an account of the results obtained from them (by Holzinger), we may first ask how far the range of G is here found to extend. The answer given by the experiment appears to be quite definite. In spite of the extreme range of the performances submitted to test, the G shows itself to exist *throughout*.

This result is in complete accordance with that of earlier researches. There too, G was found to be present everywhere: in the eduction of all classes of relations; in that of all corresponding kinds of correlates; in all the classical faculties, namely, sense, memory, imagination, and intellect; in the post-classical faculty of "attention"; no less so, in the modern faculty of "intelligence".

In this older work, also, such universality had already been used as an argument against those who were inclined to regard G as measuring something petty, or even artificial.

Where the new result does surpass the previous ones is mainly in its far greater convincingness, due to the fact of all the tests being united into one single complete experiment.

§ 7. *Saturation with "G"*

But although G thus appears to be detectible in the measurement of every ability whatever, still it manifests very great differences in its degrees. Its proportion to the other constituents of the measurement admits of definite determination in a value which varies from zero to unity, and is sometimes entitled the " saturation " of the measurement with G, or the amount of " variance " attributable to this factor.

This in the present experiment, as it has been elsewhere, is lowest with motor activities. With rapidity of tapping, it is only 5 per cent. And with strength as measured by the dynamometer, it is lower still. But we must remember that far better saturations have been previously observed in respect of mentally defective children. In their case, a notable amount of G has been found present even in squeezing a dynamometer.

The percentage is also low, as on earlier occasions, with sensory discrimination ; but still not so negligible as some authors would seem to think. In the case of brightness it is 31 per cent. In that of pitch, 18 per cent.

But if now, still keeping within the sphere of sensory perception, we move on to more advanced kinds of it, then straightway we come upon the highest saturation in the whole experiment. With the visual perception of spatial relations arranged on noegenetic lines—similar in principle to, though much more complicated than, the diagrams above on page 438—with this visual perception the proportion of G amounts to no less than 80 per cent. The next highest value in the experiment is attained by a test of " generalization " ; here, several particular facts are supplied and the subject has to infer some general law ; G this time amounts to 65 per cent. From the viewpoint of ordinary introspective analysis, these two

tests would appear to be almost polar opposites; the one comes from sensory perception, the other from thought; the one deals mainly with relations of likeness, the other with those of evidence; the one depends much on speed, the other little. The sole character which they appear to possess in common is that both are mainly governed by the laws of *noegenesis* (see Chapter XXXIV).

So soon as the tests *introduce* memory, the G-content *begins* to diminish. In such tests, it generally comes to something about 30 per cent. From this and other observations, the conclusion seems to be that G is *not* involved in the laws of retentivity, either that of "disposition" or that of "inertia" (Chapters XXIX and XXX). Reverting to other and earlier experiments, we find corroboration:

> "the 'G' manifested in eduction has nothing in common with the retentivity manifested in acquiring dispositions."

and that "the two ('G' and inertia)" vary independently of each other.

The same fact has recently been strikingly demonstrated by Billings. He trained a number of students in a variety of sciences: arithmetic, physics, mechanics, economics, sociology, geography, and history. He then submitted these students to two kinds of examination: the one was in respect of the "information" taught; the other imposed "problems" on the same subjects. As regards the results:

> "These experiments show a lower correlation between information and the ability to solve problems in the same subject than between the ability to solve problems in different subjects."

> "The results of this study seem to substantiate the view that 'problem-solving' is a general ability, 'factor,' or function. Thus, an individual, other things being equal,

should function in this capacity relatively as efficiently in one field as another."

"Since these correlations meet the criterion of 'tetrad equation' it may be that problem-solving represents 'g.'"

Incidentally, he found that the information was given better by the female students; whereas the problems were better solved by the males. The problem-finding correlated better with other tests given to the students; but information, better with success at the university examinations.

Passing to the fourth great classical faculty, that of creative "imagination", the Chicago research shows an extreme contrast. So long as the creativeness is taken to mean that which occurs by virtue of the noegenetic law of correlates, so long the saturation with G remains at its highest level. But immediately the creativeness is taken to signify the "free" or "uncontrolled" course of imagining, then down goes the saturation to its lowest level of all. Thus with the test of ink-blots, it is only ·02. This is a much smaller amount even than those found previously in such cases by Hargreaves. (Possibly, this slight divergence of results for similar tests is due to differences in the manner of scoring.)

Let us turn to the fifth faculty, that of "attention". This, as mentioned, was represented in the present experiment by various tasks which the subject had to perform "in his head"; as, for instance, mental arithmetic. The saturation with G turned out to have the tolerable but not excessive amount of about 30 per cent. Now, in such performances, the sole difficulty lies in keeping all the relevant items in mind at the same time. But if this be so, then the G would seem to be in some degree a matter of "span"; it would measure the same quantity as is ruled by the law of "constant output". The present result, then, corroborates those of several other workers on span of attention; notably McQueen and Strasheim. It agrees, too, with a former conclusion that:

> "both the intensity and the extensity of cognitive operations depend on 'g.'"

However, what is here called the "intensity" of operation has itself two dimensions; for it has been shown to divide up into goodness or accuracy on the one hand and speed on the other:

> "The connection between the goodness and the speed is that of being interchangeable. If the conditions of the case are such as to eliminate the influence of speed, then 'g' measures goodness, and vice versa. When—as is most usual—both influences are in play, then 'g' measures the efficiency compounded of both."

Altogether, then, the cognitive power expressed in G works in *three* dimensions, goodness (clearness), speed, and extensity.

With respect to the remaining laws of cognition—those of fatigue, conative control, and basal conditions—the Chicago work does not add much new to the conclusions reached previously, and to some extent already familiar to common sense, but at least nowhere contradicts them.

As regards fatigue, to take this first, its connection with abilities of all sorts is indicated by the obvious fact that it impairs them all. Conventionally, however, a person's abilities—whether as measured by G or otherwise—are taken to be those which he possesses when *not* tired. And indeed, in properly conducted tests, the influence of fatigue is more or less successfully eliminated.

As for the conative control, something similar may be said. Certainly, the complete stoppage of the conation is disastrous for the cognition. But still the influence of such minor slackenings of the conation as normally occur in testing appear to be unexpectedly small.

> "We saw that the value obtained for an individual's 'g' was not—when measured properly—dependent to any appreciable extent upon his intensity of effort. This

> conclusion held good whether we regarded the effort as a general mental function, or as a special attitude towards the mental tests, or even as a concentration of 'attention' if the latter term be understood according to the most common definitions of it."

There remains to consider how G is affected by the law of basal conditions. The chief of these, as we saw above (Chapter XXXVI), are: Age, Health, Sex, and Heredity. The most important fact observed about their connection with G, as distinguished from other determinations of "intelligence" and so forth, is in respect of age. For the G seems to arrive earlier at full maturity. Whereas the ordinary determinations continue to show improvement up to 14, 15, 16, and even 20 years, the best test of G seems to indicate cessation of growth at 13 or earlier.

And this fact is in good accord with the abovementioned insightful or "noegenetic" character of G. For such a character, so far as one can see, might well ripen in youth, whereas processes which are not noegenetic but reproductive, evidently can receive facilitations throughout life.

To close this account of the degrees with which G enters into the great variety of abilities that have been examined, it seems of interest to quote for comparison the G-content of the three standard tests; those of Otis, Kuhlmann-Anderson, and Morgan. The contents were found in the Chicago research to be respectively: 67 per cent, 69 per cent, and 62 per cent. That is to say, they about come up to the single test of generalization, but remain far behind that of the noegenetic perception of form.

On the whole, the observed saturations with G do not fit well into the time-honoured doctrine of faculties. The selfsame faculty may in some cases display a very small amount of G, but in other cases a very large amount. This we have seen to occur both with

sensory perception and with imagination. Again, no justification has been found for the traditional exaltation of thought over perception, or of reasoning (relations of evidence) over description (relations of likeness). This exaltation seems to have derived from the early interest of psychologists in the theory of knowledge. It is not supported by any superiority in respect of G. On the other hand, the G-findings do make clean fits with the scheme of psychological laws. That which is measured by G seems to include all noegenesis, but to exclude all retentivity. Again, G seems to coincide fundamentally with mental output. It is totally dependent, too, on the influences expressed in the laws of conation, of fatigue, and of basal conditions.

§ 8. *Nature of "G"*

So far in this chapter, we have recorded a comprehensive system of facts, derived either from observation or from mathematics, *about* G. There remains, accordingly, still to determine the nature of this G in itself. And here nothing can reasonably be expected other than more or less provisional hypotheses. The case has already been compared with that of electricity, where the observation of certain regularities lead on to the conception of something that will account for them; be this a "vital fluid", a multitude of "electrons", or anything else. About such hypotheses there is no finality, but continual progress.

> "Even the most complete demonstration that G and S exist, would not of itself afford the smallest indication as to the nature of what these two factors represent. To reveal this nature is quite a different business, and one that leaves room for widely divergent views. A decision can only develop in a gradual manner, as the relevant actual observations are accumulated."

Let us, then, briefly consider what have been the solutions principally advocated up to the present day. One suggestion at once indicated, and subsequently most widely favoured of all, is that G measures "intelligence". But against such a view militates the unfortunate fact that this word, as commonly used, has little if any definite meaning.

R. Cattell has portrayed the situation as follows:

> "G may or may not be the same as 'intelligence'; their relationship depends upon the particular definition of the latter adopted. But in so far as there is a common meaning to the word intelligence, we may say that it corresponds closely to G."

However, in the light of what we have just seen, the whole question has moved on. The factor analysis has revealed that such tests of intelligence as those of Otis contain G up to about 60 per cent. We are left asking the nature of the remaining 40 per cent.

The next most frequently adopted interpretation of G has been as measuring the power of "attention". Among the earliest proponents of this view have been Burt, Maxwell Garnett, and Woodrow.

Here again, however, the term is hopelessly vague. In order to make progress, the doctrines at issue must be restated in other concepts that are substantially equivalent but more definite.

Of these the most important is the concept of "energy" or of "power" (see Chapter XXXII). The picture becomes that of a mental factory in which the energy is supplied from a general power station to any required particular engine. G measures the constant amount of available energy.

But even this view leaves room for two fundamentally different versions. The one is simply to suppose that different individuals possess the energy in different amounts. The other alternative is that different indivi-

duals possess equal amounts of the energy, but unequal powers of concentrating it. McDougall writes as follows:

> "The general factor, 'G,' which is revealed and measured in effective mental testing, is, I suggest, not merely the quantity of energy available to the individual testee under the conditions of testing; it is rather the power of the individual to concentrate his available energy effectively upon the task in hand."

The two versions lead to some very important different practical consequences, and therefore should admit of decision, even experimental. If the direct view is correct, then the person with much G, although superior in the voluntary kind of perception, should be correspondingly inferior in simultaneous involuntary perception. Again, this direct view appears to leave to us less possibility of improving ourselves by training. Yet again, the direct view would seem to imply that the person with little G will be feebler, not only in respect of cognition, but equally so in respect of orexis.

Another interesting suggestion has come from Philpott. From a minute analysis of his records of mental work, he arrives at the conclusion that the observed fluctuations in the work done

> "are set up by elements of general purposes utility. We could conceivably bring them in by postulating a third set of elements, namely: a fairly large number of workmen. . . . If in addition we suppose the men to be available for use with any of the machines, we arrive at a fairly complete picture."

In substance, however, this explanation does not appear to depart from the conception of "energy". For the characteristic feature of this is that it can work alternatively in different engines. And just the same is the essential virtue of Philpott's "workmen".

Another attempted explanation of G is that somehow or other it arises from very numerous elements

co-operating "at random". This view of Thomson appears to be not necessarily inconsistent with any of those already mentioned. In fact, it is so vague as to be consistent with almost anything.

Another view—one which especially deserves attention on account of its authorship—is the ascription of the general factor by Kelley to "maturity, heterogeneity, etc.". As regards the "maturity", there has undoubtedly been recorded, and from very early days in the development of the doctrines, a tendency of the saturation with G to grow smaller for older subjects. And recently this has been corroborated by Garrett, Bryan, and Perl, who report in a similar sense that:

> "With increases in age, the abilities measured by our tests tend to become more and more specific."

But a still later research—and, it would seem, much the most extensive and thorough yet achieved—tends in the opposite direction. McManara finds the G saturations persist with little or no diminution throughout the entire range examined; that is to say, 10-19 years of age. No doubt, the question is difficult; it is almost impossible to vary the age of the subjects without introducing changes in other respects. But at least we seem able to say confidently that the saturation of abilities with G does *not*, as suggested, depend on age wholly, or even mainly.

About the endeavour to explain away G as being due to the disturbing "heterogeneity" of the subjects, it is hard to speak with so much respect. *All* individual differences are due to heterogeneity of some kind or other; the word has no scientific relevance until its scope is specified and justified. And anyway, heterogeneity is not, as difference of age often is, something to be eliminated in a research; it is only something to be restricted, and above all things to be definitely regulated.

Another important interpretation of the general factor

is that of Thorndike. Having set out from the atomistic doctrine that

> "the mind is a host of highly particularized and independent faculties,"

he arrives a quarter of a century later at the following result:

> "The results of such experiments are of great significance, informing us of the degree to which amounts of intellect as defined by the total series do represent increases in the same kind of thing, and are amounts of some unified, coherent fact in nature which can properly be isolated in thought from non-intellectual factors.
>
> "Our experiments on this matter will be reported elsewhere . . ., but we may note now that they indicate that intellect has a rather high degree of unity and consistency and independence of non-intellectual factors."

Many of us are hopeful that his representation of G as "some unified, coherent fact in nature" will some day be further defined by him and expanded.

Other views—supplementary rather than opposed to those given above—seek to base themselves on physiology. Here, as already seen, comes the most luminous conception of all; that of Lashley. According to this, the G would measure some "mass action" of the cortex of the brain.

§ 9. *Controversy*

To the preceding account of the theory G must be added a word on the reception which it has encountered. About this, Wynn-Jones writes:

> "The doctrine enunciated has caused more discussion than any other in the present century."

The first and largest group of its antagonists seem to

have been influenced by general conservatism. They not unnaturally resented so much interference with their own long-established views and habits; often, the introduction of mathematics has been found particularly irksome. This group has produced little if any counter-argument; it relies on the much more effective attitude of passive resistance.

Another contingent of antagonists to the theory consists of those who appear to have misunderstood it. In particular they have taken it to deny "group factors" (see next chapter), although really these have all been of its own finding.

A third and smaller but very active group of critics, headed by Thomson, has adopted a policy to which its advocates strongly object. The latter complain that they who actually discovered and have always devoted themselves to the "general" theory, are depicted as being only the champions of some or other sub-theory.

There remains the fourth group of censors; those who have detected weaknesses which the advocates themselves have admitted to be well founded. Such criticisms as these—even if only destructive, and still more so if constructive—have, of course, been welcomed by everybody. In fact the advocates claim to have found in these the best incitement to further progress. Outstanding among critics of this type have been J. B. Wilson, who raised the fundamental problem of "uniqueness", and William Brown, who put on a scientific basis the study of the frequency distributions of "tetrads", showing eventually how the observed distribution does fit the theory of Two Factors, but *not* that of Random Sampling. Relevant here is the statement of F. C. Thomas:

> "Criticism, then, has been forthcoming, and has been of great value. The theory has benefited by it, and, we shall maintain here, it stands to-day more firmly than before."

On the whole, the *general* theory would appear to be now explicitly or implicitly accepted by everybody who counts in this domain. As early as 1931 that competent and unbiased authority, Otis, could write as follows :

> " Are we not now all in agreement that there is a general factor common to all intellectual activities, that there are many factors each specific to one and only one ability, and that there are still other factors called group factors that are common to some but not to all of these ? If so, then is there still any controversy, and just where is the difference of opinion ? "

About the same time Brigham ironically remarked that :

> " In this country (U.S.A.) his theories (Two Factors) seem almost universally rejected in debate and accepted in practice."

In 1936 Banks writes more positively :

> " The Two-Factor Theory neatly and precisely embraces the partial truths of all the rival doctrines. For the G factor accounts for the measure of truth underlying the Monarchic doctrine of a single unitary power ; the *group factor* explains the persistent adherence of ' common sense ' to the old ' faculties ' of the Oligarchic view ; and the *specific* factors explain the Anarchic conception of intelligence as constituted by a host of independent functions."

Indeed, the general theory would appear to have now been accepted even by those writers who are most commonly credited with opposing it. This not only applies to those who had previously been sceptical, as Garrett, Hull, and C. S. Myers. It may be said even of the quondam most inveterate antagonists, Thomson, Kelley, and Thorndike.

As for the testimony of statisticians, many precious corroborations and extensions have been supplied by such authorities as Holzinger, Irwin, Piaggio, Wilson,

Wishart, and Yule, reaching their climax quite recently in the appreciation of the theory by the mathematician Darmois, as being not only correct, but even "beautiful" (Preface to Brachet's French translation of *The Abilities of Man*).

Accordingly, the doctrine is being more and more regularly included in manuals which—like the excellent one of Jha—aim at summarizing the chief developments of modern psychology.

§ 10. *Upshot*

We have been considering an attempt, founded on correlational coefficients, to furnish psychology with a new foundation. To its bases of faculties, analysis, and laws has been added that of "factors"; in particular, that of the factor called G.

One distinguishing characteristic of this movement is its comparatively high degree of modernness. For whereas the great majority of psychological theorems were already in full bloom thousands of years ago—or even went back still further, namely, to ordinary common sense—the Factor Theory seems to have no early precursor whatever, but instead to have come like a bolt from the blue about only a quarter of a century ago. Another characteristic is that, once started, it has always been steadily progressing. Every two or three years at most, there has been set up some new landmark of advance.

An instance of the scientific results already in course of being achieved by G is its usage to supplant all current determinations of "mental age" or "general intelligence". For it claims to perform all the offices attempted by these, with the inestimable advantage of substituting a stable well-defined value for a vacillating and highly equivocal one.

Larger still are the prospects held out by G for the not distant future. An outstanding example is its suggested property of being innate. Such a property, if ever proven, might enable it almost to re-create important spheres of sociology and anthropology.

Finally, if and when G attains to such a dominant position in individual psychology, this fact can scarcely fail to have repercussions in general psychology also. The whole topic of cognition might come to have that of G for its focus.

CHAPTER XLI

SPECIFIC FACTORS IN ABILITY

§ 1. " G " and " S " as Partners. § 2. Information about the S's. § 3. Broad and Group Factors. § 4. Broad Factor in Language. § 5. Broad Factors in Science. M, V, and W. § 6. Case of Retentivity. § 7. Case of Speed. § 8. " F ", " O ", and " P ". § 9. Energy and Engines. § 10. Upshot.

§ 1. *" G " and " S " as Partners*

The last chapter has been almost exclusively devoted to an account of G. Let us now turn to S. We recall that, according to the Two Factor theory, when any individual obtains any score at any test or other performance, one part of this score can be assigned to G, and then S is the remainder. But in consequence of this fact, S may have a very miscellaneous composition and, unlike G, urgently need analysis.

In particular, the equation I represents the ideal rather than any actual state of affairs. On turning to actual practice, every measurement is found to contain a certain amount of " error ". This we have not so far taken into consideration. Bringing it into account, we no longer have simply $A = G + S$, but rather $A' = G + S'$, where A' stands for A plus E, the error, and S' for S plus E. In this way we get, in a form now much used :

$$A' = G + S + E \quad . \quad . \quad . \quad (II)$$

so that A' is here expressed not in two but in *three* factors. And there is nothing to prevent the subdivision from going much further. Thus, E may be divided into a

constant part E′ and a randomly variable part E″, so that the equation becomes :

$$A' = G + S + E' + E'' \quad . \quad . \quad (III)$$

A large E″ means that the measurement A′ has low "reliability", whereas a large E′ means that it has low "validity". Such subdivisions seem never to be needed in the case of G, but in that of S they are quite common, as we shall see.

Naturally, everyone agrees that E should be reduced to its smallest possible dimensions. And at least it must at any rate be rendered approximately random. In that case, E can for many purposes—not for others—be rendered statistically innocuous.

When E is thus made random, then G and S are mutually independent ; the fact of an individual having a high G is no indication at all as to whether his S for any specific kind of performance will be high or low. To this independence of G and S in individuals there are many important corollaries. In order that a person should possess the highest capacity for any walk n life, he must needs possess both the G and the elevant S in high degrees. Medium success may e expected either from medium degrees of each, or else rom high degree of either coupled with low degree of the ther. When both G and the S are low, the case aturally becomes hopeless.

Illustrative of these relations is the following remark hich an eminent musician once made to the present riter concerning a common friend : "By force of inlligence she even understands music". Evidently, a rge G with only a moderate musical S.

Let us see how all this works out in practice. Take, r example, the vital matter of choosing a vocation. bservation has shown that different kinds of work quire G in different amounts. The person who has

too little is inefficient. He who has too much is being wasted. Probably he is also discontented ; he may even become a social danger. The choice of a person's vocation having been thus drastically limited by consideration of his endowment with G, a further narrow selection derives from the need that he should take up some work for which he has, or can acquire, the best S. And here we must recall the weighty theorem that the different S's from which the person has to choose are infinitely numerous and have randomly varying values. If so, everybody must be a genius at some few things and an idiot at some few others. A person's choice of the right S is, then, vital for him. We might almost call the indications of G and S final, had not the choice furthermore to satisfy the exigencies that derive from orectic and social, not to say hygienic, grounds.

§ 2. *Information about the S's*

As before in the case of G, so now in that of any of the S's, when once its value has been uniquely determined, the next thing is to discover as much as possible about it. Thus again we come upon the Copernican inversion of procedure.

One cardinal piece of information about the S is the fact that in any ability its amount, or "saturation" or "variance" and that of G are supplementary to one another. The more of either of the two in any ability, the less of the other.

The abilities involving much S have been found to fall into a few main categories. Firstly come those in which the issue chiefly depends on the sense organs or their specific neural connections. S rather than G takes most account, for instance, of success in distinguishing two dots, or in perceiving a difference of musical pitch. Secondly come those operations which depend on the

motor organs and connections. Mainly on the S's falls the credit for such feats as carrying a sack of coals, giving a knock-out blow on the chin, or earning a "Varsity blue". And, in the third place, there are all the feats of bare retentivity. When a bridge player fails to recall what trumps are out, it is on a deficiency of his S rather than his G that the blame should be laid.

Furthermore, a person's S includes, besides the benefit he derives from all his powers, that advantage also which comes from the good hap of his previous experiences. Take, for instance, the test (Binet) which requires that a child of seven years should be able to name the days of the week. This he could not possibly do unless the days had previously been told him. And, to this extent, the test is less a matter of G than of S.

Owing to this large dependence of S upon experience, as also its liability to have a very complicated structure, it is far harder than G to investigate. In particular, its values are much more subject to changes not easily explained.

§ 3. *Broad and Group Factors*

Next, let us recall from the preceding chapter that an S may be either "narrow" or "broad". That is to say, it may either extend over a small range of performance, or else over a large range. In the former and much more usual alternative, when all the S's in any set of tests have narrow ranges, then these are not very likely to overlap one another; instead, they will in most cases be mutually independent; and if so, the criterion I (or II) will be satisfied and the correlations will be "hierarchical". Conversely, when several tests in a set have broad S's, then some overlap between them is likely enough; this time the criterion I may *not* be satisfied.

Any such overlap between different S's in a set of tests is called a "group" factor. (Note that there can never be any overlap between S and G.)

Some idea of the ranges of performance at issue may be gathered from a few concrete examples. Suppose a set of tests to contain both the discrimination of brightness and that of pitch. Are these two performances sufficiently alike to produce overlap between them? Or, what comes to the same thing, is any factor present which is broad enough to produce such overlap? At first sight, the answer might be in the affirmative. For, after all, both the tests deal with sensory discrimination; so that many psychologists would forthwith say that both belong to the same function and, therefore, decidedly overlap. Actual research, however, as long ago as that of Carey, answered definitely in the negative. And the new Chicago experiment we are chiefly quoting here makes just the same reply. The likeness involved in the fact of both tests dealing with sensory discrimination is *not* great enough to produce appreciable overlap; equations I and II suffer no disturbance.

Let us take another example. On more than one occasion a set of tests has included: (*a*) the operation of ticking off every *e* in a printed page; and (*b*) doing the same to every *o*. What is the result this time? Here, not only the form of treatment but even the content treated show marked similarity in the two performances. Is the similarity now so great that overlap does ensue? The answer this time is, Yes. The equations I and II do break down.

Such overlap, it may be remarked, was much less obvious in the older than it has been in the newer researches. One reason is that the earlier workers purposely put together tests as different as possible, whereas the late-comers turned to the cases of greater resemblance. The other reason is that the later work naturally became

more accurate, and therefore revealed finer detail. Indeed, if by some enchantment *all* detail could be revealed, then, one must believe, overlap would be manifested everywhere; I would be exactly satisfied nowhere.

From all this, we may note that the precise limits of variation within which these equations are satisfied, are not determined by theoretical considerations, but by actual observation. In such respect, they are analogous to the limits of elasticity as determined for different physical solids.

§ 4. *Broad Factor in Language*

Of the two kinds of factors, narrow and broad, obviously the former have in general far less importance. For, as already said, their occurrences are likely to be very infrequent. Indeed, most of the S's discovered in mental tests are probably mere "stunts" that will never be encountered anywhere else.

In consequence, the development of the theory of Two Factors in respect of the S-factors has been chiefly directed in search of the "broad" ones. Now, among these a conspicuous position has been taken by what is often called the "verbal" factor.

Of course, the influence of words upon thought has been the subject of keenest discussion since time immemorial (as indicated in Chapter XVI). Inevitably, too, what was called mere verbal ability became a topic of vital importance in mental tests so soon as these were employed in comparisons between persons belonging to different nationalities.

But for the first attempt to pursue the study along the lines of the theory of Factors we have to thank the research of Davey. The result was to indicate a specific factor, small in amount, but broad enough to extend through every test of verbal memory. Still it could not

be called a verbal factor *in general*, since it did not extend through verbal operations of all kinds. This was strikingly demonstrated in Davey's ingenious procedure by "matching":

> "Here 243 children were given four well-known abstract and verbal tests, namely, Analogies, Completion, Classification, and Questions. But with each of these was matched another test having in every possible way the same form, but this time being pictorial instead of abstract and verbal."

This time, when the verbal tests are quite like the non-verbal ones in respect of the matter presented and only differ from these in the verbal manner of presentation, *the verbal factor has disappeared.*

Three years afterwards, however, this original work was impeached by Kelley, who maintained that in it the importance and extent of a verbal factor had been underestimated. For his part, he believed that:

> "fully one half of G is represented by a verbal factor."

Two years later still, the matter was taken up by Stephenson. This time eight tests were devised as being "verbal" and eight others as "non-verbal"; the former kind "made use of printed words, phrases, or sentences, or paragraphs"; the other kind included such tasks as fitting shapes and completing pictures. This time, the verbal tests certainly displayed a common factor over and above G. But nevertheless the author writes:

> "The non-verbal and verbal subtests have a high correlation, amounting to 0·82 for a summed correlation for many subtests of both kinds. The fact stands in opposition to the opinions that have sometimes depicted the two abilities as independent."

He does not calculate the actual amount of the verbal factor in these verbal tests, but his data indicate that it was about 30 per cent.

Subsequently, very similar amounts were obtained by W. Alexander, these again being in the neighbourhood of 30 per cent. More recently still, Clarke, working under the guidance of Stephenson, reported that:

> "There is evidence for v-factor amongst verbal tests, although this is not as significant as might have been expected."

Actually, however, her amounts are not very different from those which had previously been obtained by Stephenson; they were again in the neighbourhood of 25 per cent.

Finally, we come to the recent investigation at Chicago. This time the amounts were appreciably smaller; only about 10 per cent.

On the whole, then, the amounts found for the verbal factor in different experiments have presented appreciable variation. Nor is this result at all surprising, seeing how widely the conditions have differed. Naturally enough, the different tests called verbal may really involve language in unequal degrees. And such degrees can furthermore largely depend on the subjects tested. With young children, for instance, the difficulty in doing a task may lie chiefly in understanding the language used in explaining it, whereas with older children this element of difficulty may disappear. Taking such influences into consideration the course of research seems to have been remarkably consistent. Anyway, the general fact is unmistakable, that the second commonest factor in ability—lagging in most mental tests very far behind the first factor G—is of a kind not ineptly designated as "verbal".

To penetrate a little further into this matter, and to ascertain not merely the presence of this verbal factor but also its psychological nature, was one of the chief missions of the experiment at Chicago. With this end in

view, a set of tests had been constructed on the lines that seemed to supply the best general outline of verbal activity; much help was here afforded by the previous work of Riley under the direction of T. V. Moore. First of all, there was a general division made between the power of linguistic comprehension and that of linguistic expression. The former was subdivided into the four stages of Recognizing letters, Recognizing words, Understanding words, and Understanding paragraphs. The expression, on the other hand, was subdivided into Choice of Words, Correctness of Grammar, Excellence of Composition, and Soundness of Generalization. Furthermore, a comparative test was added on the recognition of spatial forms which, without actually serving as letters or other symbols, were of the same general intrinsic nature.

The results were definite enough. Every one of the eight linguistic tests showed the presence of a verbal factor, and moreover in about the same comparatively low amount; round about 10 per cent. As this amount was found in the primitive tests such as recognizing syllables and words, no less than in the more developed tests of understanding paragraphs and generalizing, the factor must needs consist of something that is already present in the primitive cases. Two explanations at once suggest themselves. Either this factor lies in the power of perceiving the visual form, or else it lies in the associating of this form with its meaning. But the former alternative seems to be disproved. For the test containing such forms to be perceived, but *not* employed in language, did *not* show any verbal factor. There appears to remain only the other alternative; this is, that the factor consists merely in the power or experience of associating a visual form with a meaning, however elementary. A corollary is that this factor cannot well consist in, or even include, the higher powers which

language confers, such as those of abstracting and generalizing; these, then, must be ascribed instead to the domain of G.

So much for the nature of the verbal factor as deduced from the Chicago set of tests dealing explicitly with the chief phases of linguistic ability. We go on to ask where else in this experiment did the verbal factor manifest itself. In the first place, it appeared in all the tests that were constructed on approved verbal forms for estimating "intelligence"; such as the admirable tests due to Burt and to Woodworth and called Analogies. In such tests, the amount of the verbal factor was round about 20 per cent. In the standard tests of Otis, Kuhlmann-Anderson, and Morgan, it was about 15 per cent. Another extensive sphere of this verbal factor in about the same amount consisted in all the tests of verbal memory. There was one more and that a highly suggestive appearance of the factor; it was in the test of "information". Here it amounted to about 25 per cent. No less significant than all these cases where the verbal factor appeared are the cases, three or four times more numerous still, where it did *not* appear. These included not only perception and imagination, not only all the fundamental operations of science, but also both psychological and aesthetic ability. And, on the whole, these Chicago results were in very good harmony with those—so far as they went—which had been obtained previously.

§ 5. *Broad Factors in Science. M, V, and W*

Turning from Literature to Science, we find the situation in respect of specific factors still more difficult, but at least equally promising. Here the relations involved, as we have seen in Chapter XVII, are essentially those of conjunction, of space and of time, with the contested addition of "cause".

The relation of conjunction, to take this first, constitutes arithmetic (including algebra). In its simplest and most fundamental form it involves two (often simultaneous) steps. In the first of these, any two or more items A and B are regarded as unities; these manners of regard are essentially subjective and more or less arbitrary (see Chapters XXIII and XXIV). In the second step the two items are no less subjectively joined together; they thereby constitute A + B. On this basis, all the rest of pure arithmetic is built up by sheer complexity. Primarily, moreover, it is all noegenetic and eductive (see Chapter XXXIV). But in practice, here as elsewhere, noegenesis breaks down on the limitations of span; the complexity is too great for the human mind to cope with; the eduction is more or less eked out by reproduction. This happens first and foremost in those elementary arithmetical operations which are entitled Computation. Thus, a person's span is in general not nearly large enough really to understand that nine times eight is seventy-two. Instead, he just remembers that it is so. Now, the first great finding of factor psychology in arithmetic has concerned the relation between this reproductive power of Computation and the higher powers specially involved in Problems, Rules, and Mental Arithmetic. After the pioneering work of William Brown and the clever experiments of Rogers, the essential point was definitely raised and met by Collar. He found that no such higher specific powers exist. The supposed cases differ from the lower power solely in the fact of involving more G. Accordingly, if we eliminate G from consideration, arithmetical ability would seem to involve nothing specific other than such reproductive powers as that of computing. A strong analogy is presented by this computative factor to the foregoing verbal factor. But, interestingly enough, these two are independent of one another.

Let us go on from the conjunctive to the spatial relation; in science, from arithmetic to geometry. Here the chief finding has been that these two—save for their common constituent G—are mutually independent. Contrary to popular belief, even that of most mathematical teachers, there is *no general mathematical ability*. On eliminating G, the arithmetical and the geometrical processes have been found to have zero inter-correlation.

Next, omitting the relations of time—which have been little studied and would seem to present much analogy with those of space—we come to the relations of cause, as exemplified in the science of mechanics. Here, the outstanding work has been that of Cox, who found that mechanical ability does involve some common factor called M, over and above G. But it proved to be of a curiously elusive nature. For subsequent observation by McFarlane paradoxically indicated that this M is manifested only by boys, not by girls. An explanation was attempted by Cox as follows:

> " This striking sexual difference raises the query as to whether such a group factor in the case of boys may not derive from acquired rather than innate ability. Daily observation shows that many boys, unlike almost all girls, tend already in their second year of life to play with mechanical instruments in a very thorough way, which can scarcely fail to help them subsequently in all performances of a kindred nature."

Quite recently, however, the situation has been developed in a singularly interesting fashion by W. Alexander. He discovered a common factor, which he called F, involved in what are known as " performance " tests and have been chiefly devised and studied by Pintner. The nature of such tests is exemplified in the following instance, due to Alexander himself:

> " the subject is presented with a box in which are placed a number of wooden blocks. The task is to transfer one of

> these blocks from one side of the box to the other. . . . In the solution the subject must not lift the blocks out of the box but must move them in the limited space that remains in the box."

Now this new factor proved to extend beyond the said "performances". It reached also to the mechanical tests of Cox, and presumably could be identified with the latter's M. But furthermore, this F or M was found to be present in measurements obtained of the subjects' efficiency in what was called "shop work" (Engineering, etc.). On the other hand, it was independent of the tests of perception of spatial form; these he finds—in agreement with much other work—to have no common factor throughout (excepting as always the universal G). On this basis, Alexander daringly takes the F or M to represent "practical" ability. Yet another factor was found by him; it showed itself throughout scholastic achievements (Mechanical Drawing, Mathematics, Science, and English), but nowhere else. Calling this X, he provisionally took it to measure something of the nature of "persistence". So far as can be seen, it is identical with the *p* discovered fifteen years earlier by Carey (*not* the P of Lankes). It seems even to be much the same as the "W" found by Webb a little earlier still; this conclusion would appear to be directly supported by the recent work of J. Russell in the relation of Intellectual, Temperamental, and Other Qualities to Success at School. If so, it is not, strictly speaking, an ability at all, but a trait of character.

In all, then, Alexander was left with four broad factors: G, V, M, and X (W). He proceeded to consider how much they respectively enter into School Success. Beginning with English, this was found to involve the three factors G, V, and X; and these were present in the relative percentages of 10, 67, and 23 respectively. Thus V is most important, G least so:

> ". . . we may note that, testing G and V with intelligence scales, we should be fairly successful in prediction of success in English, since we should have covered 73 per cent of the total variance. We know from experience that scholastic guidance in this sphere is fairly successful when based on verbal intelligence tests alone. That we occasionally meet cases where pupils do not succeed, despite the fact that they scored well in such tests, is to be explained by the fact that we neglected X."

Turning to Mathematics, here again G, V, and X appeared to be involved, but this time in the quite different percentages of 31, 19, and 48:

> "This difference in the relative importance of the factors in different subjects is a matter of great interest. It is the explanation of much that was not understood in guidance before. It is common practice to use the same test of 'intelligence' to predict success in these two subjects. . . . If the loadings in a test are such that it is good for prediction of success in English, it necessarily follows that these loadings are wrong for prediction of success in mathematics."

Going on to Science, this time the percentages were 12, 31, and 55. Note the remarkable contrast between scientific ability as measured here by scholastic achievement and as measured in the Chicago experiment by the fundamental processes involved. The former ability, quite unlike the latter, contains a considerable amount of the verbal factor. Moreover, the scholastic science shows a striking absence of the practical factor M (F). This is explained by Alexander as follows:

> "Science is sometimes reduced to a verbal or abstract subject. Rather than carry out an experiment in chemistry, pupils are sometimes expected to study chemical text-books and learn chemical equations. In such case there is nothing concrete in the subject and indeed it comes close to mathematics."

Note also in the scholastic achievement the dominant significance of X.

Only when we arrive at such practical achievements as shop work and mechanical drawing does F (M) come on the scene, whereas V disappears from it. G, X, and F now show percentages of 10, 13, and 43 respectively, most of the balance being attributed by Alexander to a suggested "number factor" (our "computation" factor, it would seem).

When to all such vital matters in respect of school success are added analogous considerations in respect of ordinary adult life, not to mention the multitudinous implications for states abnormal and pathological, psychology would in these factors appear to have gained access to a region of extraordinary importance; certainly, one far beyond what could ever be obtained by unaided "common sense

§ 6. *Case of Retentivity*

Our next case of a possible factor illustrates more of the difficulties attending such investigation. It is the case of retentiveness. This property, as we have seen, appears to be independent of G. But there still remains the quite distinct question as to whether it is in itself a functional unity, or instead breaks up into many. Is it "monarchic" or "anarchic"?

The plain man, at any rate, seems to reply in the former sense. Nothing is commoner than to hear him speak of his own or some other person's memory as being "good" or "bad" in general, thereby implying that it functions as a single thing. But, on the other hand, he is just as ready to adopt upon occasion the opposite view; for instance, he may lament his inability to keep in mind how many trumps are out and yet claim to have an excellent remembrance for loans of money.

Experimentally, the earliest evidence was affirmative again. In fact, the very first broad specific factor discovered was of this nature. The present writer reported :

> " . . . the overlap found between the memorizing of syllables and that of numbers. This observation was said: ' to indicate the possibility of a rather extensive group of performances being so nearly related, that they might be gathered together as a more or less unitary ability under the concept of " memorization " '."

And the work afterwards done in his laboratory by Carey seemed to corroborate this :

> " The result of the experiments was to show that such a memory factor, common to both visual and auditory memorizing, is not only present but amounts to the considerable value of ·32."

Kelley in 1928 again reports a " memory factor ". So, too, in 1930 Anastasi obtained :

> " . . . evidence of the presence of a central factor through the memory tests."

On the other hand, this very author two years later concludes negatively as follows :

> " The chief conclusion that can be drawn from the present study is, clearly, that we cannot speak of a single common factor running through *all* forms of memory."

Again, Weinberg, in 1933, finds a certain divorce between the memory that is " logical " and that which is " brute ". Furthermore, the recent Chicago research leads to a similar denial of any general factor in memory.

The solution of the seeming conflict is no doubt that which was given by Anastasi. There is no factor (other than G) that extends through *all* powers of remembering or reproducing ; there is, then, no factor of retentivity *in general*. But there do occur factors extending through several particular large regions of remembrance. As for

the origin of these particular cases, Anastasi concludes—in good agreement with the present writer :

> " The common factor previously found may have consisted almost entirely of certain special devices which could be applied generally to rote memory for verbal material."

§ 7. *Case of Speed*

Another attribute presenting not a little difficulty is that of speed. Is this a general factor, in the sense that the person who is found to be quick in some mental processes will show a similar quickness in others ? Here once more the man in the street is inclined without reflection to answer in the affirmative. And he will persist in this opinion even if you tell him that you mean quickness apart from " intelligence " ; he will probably be able to cite many persons who are " slow but sure ".

However, the results of the experiments of Bernstein were negative ; they failed to show any general ability to work fast apart from working well ; this was at any rate the case with all processes that were mainly eductive. Instead Bernstein corroborated the already mentioned theorem that quality and speed of response constitute interchangeable virtues. He who on an average can excel in one respect can also on an average excel in the other. In either case his superiority will only be due to his excellence in G, not in any S.

But these experiments, though not demonstrating any general speed ability, did show a general speed *preference* ; some subjects were on all occasions fast and slap-dash, whilst others were slow and careful.

However, the situation changes when we turn to the tests that depend mainly on processes which are other than eductive ; that is to say, which are sensory, motor, or reproductive. The evidence is particularly abundant in the case of voluntary movement, such as rates of

tapping, or of reacting. Into such performances—as is especially demonstrated by the Chicago work—there does seem to enter one or more broad factors of speed that have nothing to do with G.

The suggestion has been made by Hargreaves that at bottom this factor may be mainly of conative origin. Conceivably, it might even prove to be essentially of a motor nature.

§ 8. *"F", "O", and "P"*

Even more intriguing than all the above-mentioned broad specific factors in ability are certain other factors, which have been designated by the letters F, O, and P, and which possess even greater breadth but of a different kind. In particular these factors, though discovered and measured in terms of mental ability, have been found to extend their scope to the region of character. Consequently, we shall barely mention them here, and consider them more thoroughly in the next chapter.

Taking first F, this letter was intended to suggest that the factor is characterized by something analogous to fluency (it had nothing to do with the F of Alexander). The tests in which it has been most clearly manifested are those which require abundant reproductive rather than noegenetic response to such material as words or pictures. Conspicuous among such tests are those of seeing familiar figures in fires, clouds, or ink-blots.

As for O, this letter does not, like the ones so far mentioned, readily represent any kind of ability at all; it expresses rather the fluctuations in this. Any person is set to work for an hour or so and measurement is made, not only of his average output, but also of his deviations from this average (see chapter on Fatigue).

There remains P. This letter is meant to indicate

that a broad factor has been detected which—on first sight, at any rate—seems to be of the nature of "perseveration". That is to say, the mental processes in question appear to display a sort of inertia; they are found slow to start, and slow again to stop. To verify this view, observation was made by Bernstein on the capacity of children to adapt themselves to change in conditions of class work.

He writes as follows:

> "Those showing least adaptability to new work, taking an inordinate time to settle down to any task and perhaps finding themselves compelled to rush through a great deal of work in the last few minutes in order to produce a tolerable output, were classed as the highest perseverators; those at the other extreme, who never appeared to experience any difficulty in starting and who quickly adapted themselves to any change imposed in the work, were classed as non-perseverators."

Now, between the perseveration thus observed and the factor P yielded by the tests, there was found to be a surprisingly high correlation.

§ 9. *Energy and Engines*

So far, we have been recording what has been reported about S with respect to actual observation. But in the case of G, we furthermore mentioned the attempts that had been made to interpret all this observation theoretically. Let us now do the same in the case of S.

G, we found, could be explained as measuring some "general energy"—probably derived from a large portion of the nervous system—such as had already seemed necessary to account for the law of Constant Output (Chapter XXXII). But "energy" as commonly conceived needs to be supplemented by "engines"

in which to operate. And such engines, it has been suggested, are supplied by the nervous system, in so far as its functions are *localized*. And in point of fact, just such localized functions would appear to constitute the abilities measured by the S's.

And if we pass on from the explanation of G as an energy to that of it as "mass action", again there is thought to be need of a supplement (see Chapter XXXII, p. 91). For the mass action can only work in and through some sort of localized functions; the former reinforces the latter. And so we are back at the S's again.

However, this explanation of the specific factors we have been considering seems not to extend to O and P. These, in fact, are not rightly termed "specific" at all. They appear rather to be as general as G itself, but in other dimensions. If G is taken to measure the *amount* of any person's supply of G, then O may represent the *instability* of that supply, whilst P may represent its *inertia* in switching from one set of engines to another.

§ 10. *Upshot*

Already in Chapter XXXIX we recorded the finding that every ability score satisfying the condition of "hierarchy" could be divided into two Factors, one "general" (G) and the other "specific" (S). But the rest of that chapter was almost entirely devoted to G.

The present chapter has turned instead to S. In every ability the range of this has been found to be very much smaller than that of G. Yet there are notable differences between some S's and others. The great majority are narrow in extreme degree, and therefore possess correspondingly slight importance. But a few,

although still far narrower than G, are at least broad in comparison with the extremely narrow ones; and even this their relative breadth is sufficient to invest them with much interest. The chief instances so far established are in respect of the following abilities: linguistic, scientific and practical, besides one or more for Speed and for Fluency.

In addition to both kinds of S's, the extremely narrow and the comparatively narrow, we have also encountered the factors designed O and P. But these are not taken to belong either to the S or to the G. Instead they are regarded as co-ordinate to G.

> "They are further aspects of the same energy; whilst to measure its quantity, the other two may represent its inertia and its oscillations."

Finally, all the valuations of the work described in Chapter XXXIX—its modernity, its progressive course, the largeness of its promises, and its great transcendence of all that appertains to common sense—all these characteristics would seem to recur here also.

CHAPTER XLII

ORECTIC FACTORS

§ 1. Extension of Method to Orexis. § 2. Discovery of " W ". § 3. Extension of " P ". § 4. Extension of " F ". § 5. Extension of " O ". § 6. Further Psychiatrical Investigation. § 7. Fate of the Orectic " Types ". § 8. New Statistical Methods. § 9. Upshot.

§ 1. *Extension of Method to Orexis*

The preceding chapters have almost exclusively considered the Theory of Factors with regard to the cognitive side of human nature. But much the same requirements as those which led to such a novel theory on this side have made themselves strongly felt on the other or orectic side also. Just like the abilities, so too the orectic traits —desires, emotions, temperaments, and types — found themselves up against the problem of coexistence.

Here, too, the inevitable remedy appeared to consist in the introduction of correlation coefficients. But then here also—indeed far more even than in the case of cognition—the coefficients presented a bewildering multitude and seemingly extreme disorder.

Accordingly, it was only to be expected that here again, as with cognition, an effort should be made to advance from correlations to " factors ", or " determinants ", as they are sometimes called.

§ 2. *Discovery of " W "*

The first great attempt in this direction was made by Webb and published in 1915. It was fairly entitled

" An Attempt at an Exact Study of Character ". The procedure consisted in testing a large number of subjects for general ability (G), rating them for many traits, calculating all the inter-correlations, and attempting to explain these in terms of factors. Although this was the first of many researches on the correlations between mental traits, it would appear to have been rarely since surpassed in the chief requirements of procedure: number of subjects, number and systematic choice of traits, together with thoroughness of rating. As for Webb's application of factorial analysis to the orectic side of the mind, here he was only too much in advance of his times. Not till now, after a lapse of over twenty years, are psychologists beginning to follow in his wake. His chief conclusion, beyond confirming the existence of G, is given by him as follows:

> " We have been able to demonstrate the existence of a second factor exerting a widely-ramifying influence on the side of character. . . . It markedly dominates all the correlations yielded by the estimates of moral qualities, the deeper social virtues, perseverance and persistence; also, on the negative side, qualities related to instability of the emotions and the lighter side of sociality. Its nature is best conceived . . . to depend upon the consistency of action resulting from deliberate volition, i.e. from will."

But here, just as in the two previous chapters, the need has been felt of a sharp distinction between the purely statistical value derived from the correlations and the interpretation of this value psychologically. The statistical value is something definite and comparatively permanent. The interpretation is extremely open to controversy and to progressive improvement. The statistical value has been denoted by the letter W. The interpretation is *provisionally* derived, as Webb says, from the " Will ".

Among his major secondary results is an explanation of

why, seeing that G is always one and the same, "intelligence" should be commonly credited with fundamental differences; one individual is said to be characteristically "quick"; another, "original"; another, "profound"; to yet another is assigned "common sense". Such uniqueness of G together with multiplicity of "intelligences" is traced by Webb to the fact of G being purely cognitive, whereas the "intelligences" usually involve something orectic, especially W. For instance, the persons who were credited with "profound" intelligence turned out to be precisely those who were rated to possess much G *and* W.

Immediately following the work of Webb came one of Burt which seemed to be intimately connected therewith, but to have suffered from meagreness of report. This time the result reached is "a general factor common to all the primary emotions". Does this mean only the lack of W? Or is it something more or less independent? Here is a question still to be settled.

Explicitly based on Webb's results was a publication made four years later by Maxwell Garnett. Introducing a new and very valuable statistical technique, he showed that certain of Webb's traits could be resolved into *three* factors: G, Z, and C, where Z seems only a purified form of Webb's W, but the letter C was intended to suggest that this factor is probably akin to "cleverness"; it was thought to be possibly connected with low degree of P.

The further lapse of fifteen years brought about further decisive technical advance. All the preceding work on W lay under a grave suspicion. The individual differences of character had been derived from estimates. But these are apt to be biassed all round in favour of the person whom the estimator likes. Such a bias or "aura", it was complained, would produce just the appearance of a general factor like W. But now at

last the momentous step was taken by Hartshorne, May, and Maller of measuring traits, not by estimates, but by objective tests. In particular, tests were devised of honesty, co-operativeness, inhibition (or self-control), and persistence, all qualities characteristic of W. These tests were applied to 807 children, and the ensuing correlations were calculated. At first, guided only by intuition, the experimenters came to the conclusion that all these qualities were independent of each other. But the subsequent application of the precise factorial technique by one of these researchers themselves, Maller, showed once more the presence of the W factor.

§ 3. *Extension of "P"*

However, this is not all. The factors shown in orexis up to the present day have not only included the preceding W, which was discovered and confined within the orectic sphere itself, but have also revealed further factors which were first encountered within the sphere of cognition and were only extended to orexis by an afterthought.

Foremost here comes the factor P which, as we saw, was taken originally to measure something of the nature of mental inertia (see previous chapter). Already Lankes showed that P was not directly but *inversely* correlated with ordinary "perseverance". More recently, tests of this factor were applied by Pinard to 194 subjects at a school for orphans and other children whose education had suffered from various anomalies and embarrassments. At the same time the matron and staff were asked to estimate the children in respect of an elaborate list of traits. But these they found not to touch the vital points. The differences that they deemed really important were in respect of being difficult, self-controlled, sociable, reserved, persevering, and unreliable. Accordingly the

investigator then had the children marked on *these* traits.

The results at first seemed to show that these and P were quite unconnected. But here again remarkable positive results were obtained by readjusting the statistical procedure. When the children were thrown into four approximately equal groups for very high, moderately high, moderately low, and very low P-values, the results became, as may at once be seen, extraordinarily significant. They are as follows:

Total Number of Cases in Group	Degree of "P" indicated by Test	Number of Cases rated to have each Trait					
		Difficult	Self-controlled	Retiring	Sociable	Persevering	Unreliable
46	very high	36	12	16	32	10	38
52	mod. high	10	37	14	33	32	15
46	mod. low	14	33	19	29	33	15
50	very low	39	8	13	32	9	37

"The V.H. group was considered to comprise the real rebels, who were irritable, bad-tempered, and moody. These, as a group, were the leaders in mischief of the V.L. group, who were petty, nagging, and whining, and were always happiest when in a crowd. The differences between the M.H. and M.L. groups were less marked, although the M.L. group was considered more self-confident, jovial, and popular than the M.H. group. Out of the 24 prefects in six houses 17 belonged to the M.L. group, 5 to the M.H. group, only 2 to the V.H. group and none at all to the V.L. group. Of these the 5 in the M.H. group were considered more reliable and better leaders from the staff's point of view than the other groups. The 2 prefects in the V.H. group were in constant conflict with the staff."

Subsequently, similar results were got from 116 adults, patients in a mental hospital :

Number	"P"	Difficult	Self-controlled	Persevering
29	V.H.	19	3	4
26	M.H.	5	15	14
29	M.L.	7	11	12
32	V.L.	16	3	2

An experiment made later still by Howard in a school for high-class children gave similar results, but far less marked. The most " difficult " children again showed an appreciable tendency to be found among those who had very high P-values ; but this time no such tendency was found among those who had very low ones.

More recent in this direction have been the results of Maginess, under the guidance of Stephenson ; he once again found that a high P-score was associated with poorness in respect of intelligence, self-control, concentration, physical energy, and character in general. As another very suggestive study of the connection between P and character may be cited that of R. Cattell. Lastly may be mentioned the corroboration afforded by Clarke in Australia. As the result of comparing together the test of P with the questionnaire estimates made by teachers, she concludes :

> " The results of the questionnaire are in agreement with Pinard's findings that the difficult child is frequently an extreme perseverator. The extreme non-perseverator, though appearing among the difficult children more frequently than the average perseverator, does not emerge from the questionnaire analysis with anything approaching the clearly marked traits of the extreme perseverator."

The following is a complete list of the traits by which the

perseverators were significantly distinguished from the others :

1. Extremes in the duration of emotions.
2. Emotions aroused with difficulty.
3. Pessimism.
4. Affected by criticism either in the direction of over-sensitiveness or of being aroused to opposition.
5. Unusual submissiveness or else reactions against authority.
6. Lethargy.
7. Inability to make small decisions quickly.
8. Few interests.
9. Untruthfulness, or extreme punctiliousness with regard to truth.
10. Lack of perseverance.

Note particularly the characteristic "ambi-valence" of the fourth, fifth, and ninth traits. The traits in which they did *not* in these experiments show a significant difference were: distractibility, speed of settling down, and selfishness.

But against all this harvest of information about the P-factor must be set two serious drawbacks. One concerns its psychological interpretation; the older view, according to which it stood for something of the nature of mental inertia, has since been challenged. Other interpretations have been attempted instead, though upon grounds which to the present writer do not so far appear to be conclusive.

The other setback to the development of the P-theory is, on the contrary, technical. The tests of this character have proved to be extremely hard to apply in any reliable manner. On the whole, however, the results appear to be astonishing enough. The tests of P are to all appearances most trivial; they only consist of such performances as writing *e*'s backwards. Nevertheless, as we have seen, they show themselves to tap the deepest strata of human character. Success in them has high

positive correlations with such traits as self-control, perseverance, and reliability. Failure, on the other hand, is highly correlated with that pregnant disposition which is called being " difficult ".

§ 4. *Extension of "F"*

The case of the Hargreaves factor F—to take this next—has a peculiar historical interest, in that its finding was much against the discoverer's own anticipation! He was engaged in reducing to factors the imaginative powers manifested in such tests as completing pictures, completing stories, saying disconnected words, and seeing objects in ink-blots. These tests of " fluency ", as he called them, were easily found to possess some common factor over and above the ever-present G. And an explanation was ready to hand in P. The suggestion was plausible that those persons were more " fluent " who were less hampered by P (interpreted as mental inertia). But, despite all his efforts, this new common factor could not be completely disposed of in any such fashion. A remnant persisted which was *independent* of P. Provisionally, then, this remnant was labelled by him as X.

Six years later, not only was this erstwhile mysterious X confirmed by R. Cattell, but by him was identified with a factor long previously reported by Maxwell Garnett, denoted by him as C, and afterwards taken to be only the reverse of P. As to its psychological nature, Cattell concludes that:

> " . . . the C temperament pattern is *not* that of the extrovert, the cyclothyme or indeed any other type so far described and labelled. True, it has some resemblance to the extrovert type, by which it is approached more closely than by any other, but there are some significant differences . . . the mental process behind the 'C+'

> mentality is a fluency of association (high in actual tests), a quickness of response and a ready ' leaping up ' of ideas and impulses."

To express this " leaping up " character, he recommends the word " surgent ".

Another investigation going on at the same time as the one just mentioned, but without any knowledge of it, was that of Studman. This investigator, working in two mental hospitals, came upon a factor which she denoted by the letter F, but which appeared to be no other than the factor of Hargreaves again. It now revealed high correlations with six traits that entered positively and negatively into the mental disorders known respectively as mania and melancholia. The positive or maniac type of patient was found to be active and enthusiastic, extremely sure of himself, fond of bossing, talkative, and expressive, glad to be alive, presenting ups and downs. Conversely, the negative type was sluggish and indifferent, unwilling to express an opinion, easily managed, silent, he always saw difficulties ahead, he maintained emotions for long periods.

Surely, the way in which one and the same factor can be picked up again and again—named *p* (so named by Casey), C, X or F, as it may be—speaks well for the objectivity of the method employed.

To conclude, as an example of how the interest of such factors irradiates over from individual to general psychology, we may here mention the work of Pachauri on the surprising superiority of remembrance of uncompleted as compared with completed tasks. He found this phenomenon to present correlations with all four factors, G, W, F, and P; in the first three, it was positive; in the fourth, negative. However, the precise significance of these correlations would seem to be still uncertain. Here and elsewhere, as shown by Wynn-Jones, the investigation of P requires great caution.

§ 5. *Extension of "O"*

Yet another factor or determinant, closely analogous to the three preceding ones, has been found in the phenomenon of "oscillation" considered in Chapter XXXIV. For this factor also has shown itself to conform to the same statistical criterion as the others (see Chapter XXXIX). And it, too, seems almost certain to have an important extension into the sphere of orexis.

So far, this extension has been but seldom investigated. Very valuable, however, would appear to be the work of Stephenson, Simmins, and Studman, which aimed at ascertaining the significance of P, F, and O in mental disorder.

The results have been taken to indicate that all the patients unequivocally suffering from the classical mania showed a high F and a low P. Those suffering from the classical melancholia showed reversely a low F and a high P. But in the "hypoactive" phases of the mania P could become high. On the other hand, in the "hyperactive" phase of the melancholia the F could become high.

Among other recent results is the finding of marked correlation between the experimentally determined O and the teachers' estimates of "unsteadiness of character".

§ 6. *Further Psychiatrical Investigation*

For another notable research—or, rather, series of researches—in the field of psycho-pathology, we have to thank T. V. Moore and his students. An elaborate examination was made of 367 patients in the field "of the essential mental disorders, the manic-depressive and

submitted to statistical treatment by the methods described above.

In the first place, this technique indicated in a purely empirical manner five general syndromes as they are called; that is to say, typical combinations of symptoms. They characterize respectively the mental disorders designated as follows: catatonic, delusional, manic, cognitive, and constitutional depressive.

But from this basis the author proceeded to make a great further advance—" it has been shown that there is not only a general factor underlying the symptoms of each syndrome, but that there is also a 'super-general' factor that gives to all the syndromes, though in varying degrees, the same background of causality ".

What is the nature of this super-general factor? To begin with, what are its correlations with each disorder? We come upon a truly remarkable fact. The factor has, naturally enough, a positive correlation with four of the syndromes. But with the fifth it correlates *negatively*. In other words, it seems to have such a peculiar nature that it aggravates all mental disorders save one alone, and that this it, on the contrary, mitigates.

The correlations are as follows:

Disorders	Catatonic	Deluded	Manic	Cognitive	Constitutional Depressive
Correlations with Super-General Factor . .	·789	·595	·490	·296	−·599

In default of any explanation by Moore, we may diffidently suggest that his super-general factor is no-

in conscientiousness, trustworthiness, kindness, and so forth. If one looks around in a mental hospital—or out of it, for that matter—one finds that the commonest of all symptoms of psychic disorder—the sole one that has such a very great breadth as characterizes the super-general factor of Moore—consists in just such a diminution of self-control.

But what, then, about the paradoxical exception in the case of the mental disorder called constitutional depression? In truth, this case would seem to be just the exception that proves the rule. For of all the disorders, this depression is perhaps the only one where conscientiousness and trustworthiness appear not to be damaged in clinical cases but improved.

There remains to consider how well this exception fits in with the results of Webb himself. Usually his W is said to correlate positively with all the traits that are biologically desirable. But to this benignant tendency there seems to be at least one exception hitherto curiously overlooked. With Webb's boys the three chief W-qualities — kindness, trustworthiness, and conscientiousness — showed appreciable correlations (·44, ·20, and ·37) with the trait described as "readiness to show fear". But fear—at any rate as probably understood by the judges in this case—includes a weakening which tends to defeat the very object in view; to this extent, it is an undesirable emotion.

Moreover, the fear has an even larger correlation with "unsoundness of constitution". Finally, the already quoted work of Studman shows W to have a negative correlation with F.

The suggestion seems not far-fetched, that to be conscientious, trustworthy, kind, and so forth may to some extent be augmented by apprehension (subconscious?) of the consequences of being otherwise. That moralizing apprehensiveness may be promoted by consti-

tutional feebleness seems to have long been suspected even by common sense.

> " The Devil was sick—the Devil a monk would be :
> The Devil was well—the devil a monk was he."

§ 7. *Fate of the Orectic "Types"*

Some of the preceding orectic " factors " are lineal descendants of what we have encountered previously as " faculties ", " temperaments ", " types ", and so forth (Chapters X and XXXVII). Thus W shows a remarkable affinity to the original " Charioteer " of Plato. Again, P was actually suggested by the " perseverative " type ; the main difference between the two consisted in that " perseveration " denoted a definite mental attribute, but left undecided whether this possessed functional unity; whereas P denoted a definite functional unity but left still undecided its mental nature. Naturally enough, then, the question now arises, What has become of all the other alleged orectic faculties, temperaments, or types of earlier date ? Most of them have passed away and left no trace whatever behind them. This has been conspicuously the fate, for instance, of the multitudinous once advocated " temperaments " ; many of these maintained themselves in repute for several centuries, yet then altogether—and, it would seem, for ever—vanished from psychology. Much the same has also happened to most of those traits which have been, or could be designated as " types ".

Characterologists no longer try to base their science on the three attributes listed by Perez, " quickness ", " slowness ", and " vehemence " ; nor on the ground-properties of Beneke, " excitability ", " powerfulness ", and " liveliness " ; nor on the " sensitive ", " active ", and " apathetic " divisions of Ribot ; nor on the nine classes of Queyrat. Only a perfunctory mention is

vouchsafed to the "heteronomous" and the "autonomous" characters of Kant and Adicke; or to the extraordinarily complex "ground-differences" of Meumann. No more than a pious reference is extended to the "receptivity", "impressionability", and "reactivity" of Bahnsen. No effective notice is now taken of the "spiritual", "personal", and "sensuous" driving forces of Klages. Rare is the genuine adoption even of the famous six ground types of Spranger: "theoretical", "economic", "aesthetic", "social", "domineering", and "religious".

But other cases have been far more fortunate. They have not only persisted but have spread themselves like a green bay-tree. Still universally famed are the "introverted" and "extroverted" types of Jung; the "schizoid" and "cycloid" types of Kretschmer; the "tetanoid" and "basedoid" types of Jaensch, to mention only the leading cases. "Typology" has become a word with which to conjure. What, then, has happened to them all? Have they, too, undergone any development comparable with that which introduced "factors"?

The answer is discouraging. On the psychological side—that is to say, in bringing the concepts of the types to greater clarity and less equivocation—there seems to have been little or no progress. For example, Kelley can still say:

> "The number of different verbal statements of the meaning to be attached to this term (introversion) falls but a little short of the number of people using it in writing."

Nor is the record more satisfactory on turning to the statistical aspect of the matter and the great question of functional unity. The types of to-day appear to suffer from exactly the same fatal defect as did the types,

temperaments, faculties, and so forth of earlier times. Line, Griffin, and Anderson must continue to deplore that:

> " . . . the types so far suggested have not withstood the piercing glance of the empircist. They by no means display that unitariness of function implied in their postulation."

Jaspers can still write:

> " lack of agreement between these measures of supposedly the same functional unity indicates that either the function of extroversion-introversion possesses very little unity or that the different investigators differ tremendously in their definitions of this function."

Guthrie can still declare about introversion and extroversion that:

> " The total impression gained is decidedly reminiscent of the accounts of the phrenological faculties."

Some authorities, as Ach, have declared perseveration, introversion, schizophrenia, to be one and the same thing. But others, no less confidently, have taken them to be three different things. Yet other writers, as Helwig, assert that the typologies of character are infinitely numerous. In short, all is still confusion and contradiction.

Reduced to this extremity, the theory of types might naturally have been expected to seek support from the more progressive theory of factors. Indeed, the two movements, the types with their wealth of psychological suggestiveness and the factors with their stable objectivity, would seem to be natural allies. But unfortunately, as we have already seen in Chapter XXXIX, the two sides have instead adopted the attitude of antagonists.

A notable exception has been afforded by Cattell, who finds a common factor, "A", in the following four types: introversion as conceived, not by Jung himself, but by McDougall; schizothyme as conceived by Kretschmer; inferiority complex as conceived, not

by Adler himself, but by his disciple Wexberg; and anal-eroticism as conceived by Ernest Jones. But unexpectedly this A is said to have no correlation with P or with O. For the whole finding there is still much need of confirmation.

§ 8. *New Statistical Methods*

Considering the immense importance of all this factor analysis and the great difficulties attending its application, much interest must be excited by any attempt to improve or extend its technique.

A long way first in the field was Maxwell Garnett, who, using trigonometry and the rotation of axes, extended the scope of determination from one to two common factors. In itself this method has not had much subsequent usage, but in principle it seems to have more or less inspired all later work.

In 1927 Kelley followed with many ingenious developments of factor values for two to five variables. But unfortunately they proved to have little applicability. In actual practice, even he himself had to employ throughout the original method outlined in Chapter XL, and commonly called that of "tetrads".

Then followed the two methods which at present seem to be exciting the liveliest interest; they are that of Thurstone (expounded from 1931 onwards) and that of Hotelling (first set forth by him in 1933 and developed by Kelley in 1935). For both methods are claimed two advantages over the original or tetrad approach: in the first place, that they deal with multiple common factors instead of only a single one; in the second place, that they involve far less laborious calculations.

However, the two parties are by no means content with one another. Kelley characterizes the method of Thurstone as:

> "having no merit except that of . . . an average of semi-disparate things."

Thurstone, on his side, charges the Hotelling-Kelley method with two fundamental defects. One is the absurdity that by it:

> "the factorial description of a trait . . . varies when the trait is moved from one battery to another."

The other is that it depicts each factor after the first as having in half of the tests a negative value. This value irrationally implies in just half the tests:

> "an ability whose possession is a detriment to the total performance. Such a situation is not conceivable."

But then the field is taken by Line and his colleagues who protest that the tetrad method *is* capable of handling many factors; only it does so singly instead of collectively. It treats them in this fashion:

> "in order that their psychological significance may be examined. And in this way a very intimate relationship is maintained between the psychological method and the statistical techniques. This relationship is of very great importance."

The authors conclude that the new technique can be very useful for some "preliminary surveys", but for final settlements should be replaced by the older and more potent tetrads. And to complete this reversion to the original tetrad method, this has now, by means of the "bi-factor" procedure of Holzinger and Swineford, been cured of its one great previous defect, laboriousness of "calculation". With this extension, it is said to be:

> "relatively *easy* as compared with other methods."

To supplement these few words on the most recent statistical methods, reference may be made to the new journal *Psychometrika*. Here is to be found, in particular, the very suggestive article of Stephenson on "The Foundation of Psychometry" (1935).

Altogether, the question of method is still—and perhaps always will be—far from settled finally. And indeed all improvements are much to be desired, considering the obstacles to be overcome. Not the least of these is the shifting nature of some of the influences in play, as reported by Anastasi, Landis, Zubin, and S. Katz, and as are implied in the work of Thorndike on " Changes in Wants, Interest, and Attitudes ".

On the other hand, even the present methods, keenly as they may be opposed to one another, have in actual practice—up to a certain point—led to remarkably concordant results. This has been shown repeatedly, as by Thomson, Alexander, Kelley, Kellogg, Thurstone, and Clarke. Accordingly, the general outlook, even in this difficult sphere of orectic factors, would seem to be extraordinarily promising.

§ 9. *Upshot*

In the present chapter the progress of the statistical technique of " factors " has been followed up from the sphere of cognition to that of orexis. The outstanding discovery recorded has been that, as the former sphere is dominated by the factor G, so is the latter one by W. With these two values known about an individual, a wonderfully long way has been travelled towards appraising his whole worth.

Further factors well determined statistically and of great significance psychologically are those called P, O, and F.

Less favourable has had to be the report on the " types ", which have excited so much interest, and have been so widely accepted. All the older ones seem to have simply vanished. Those still current appear to suffer from the present calamitous divorce between mathematical technique and psychological meaning. At

one extreme, statistical zealots have accumulating masses of figures that remain psychologically senseless. At the other extreme, no less ardent typologists have been evolving an abundance of psychological ideas with little or no genuine evidence as to their truth.

However, even here the outlook is brightening. On the one side, the statistical technique is making such progress that to ignore it becomes more and more an admission of incompetence. And on the other side, this very development of statistics is showing with increasing force where their own brief authority must come to an end.

EPILOGUE

EPILOGUE

OUR chronicle is ended.

We set out from a startling contradiction. Everywhere psychology is being lauded to the skies. And yet psychologists are split up into multitudinous schools, all fiercely warring upon each other.

Keeping this paradox in view, we have endeavoured to narrate the general course of psychology, since it left the apron strings of common sense and started to become a biological science, over two thousand years ago.

Much of its troubles we have traced to three chronic embarrassments: entanglement in the perplexities of philosophy; need of a pact with physiology; and the requirement of an adequately, though not exaggeratedly, rigorous method.

For the rest, psychology seems to have suffered in extraordinary degree from reckless simplicism; and it has sought out novelty by the facile path of destruction, rather than by the narrow way of construction.

Foremost among such negations has been the eternal rivalry between " form " and " material ".

In its earliest manifestations, this dispute was philosophical. The advocacy of form was intimately connected with that of cosmic unity (Pythagoras and other Ionians); whereas the bias towards material was partnered with the assertion of cosmic plurality (Leucippus and Democritus).

But in psychology, the bent towards form found issue in the great, initial, and still persisting doctrine of what have been called " faculties ", " powers ", " capacities ",

"temperaments", "types", and so forth. These have been taken to determine the essential forms of mental operation, and so to constitute the sole legitimate subject-matter of mental science.

The rival and much later doctrine, that which favours mental material or content, has taken the subject-matter of psychology to consist rather of sensations, these being supposedly "associated" together.

Quite recently, the pendulum has swung back again. A school has arisen which, under the name of "Gestalt", seeks once more to taboo the sensations, and to re-establish the sole dominance of form. Unfortunately, however, this school has derailed from genuine objective forms to mere subjective groupings.

However, this bent towards exclusiveness, this fixed regard of one side of the shield and disregard of the other, does not stand alone. There are many other cases of blind partiality hardly less ancient. Indeed, almost all of them were already considered—and rejected—by the father of psychology, Aristotle himself. The following may be quoted as familiar instances of them. In the language of to-day, there are the "functionalists", who repudiate the study of mental structure; whereas the "structuralists" will not hear of mental function. So, too, the "behaviourists" refuse to take account of the testimony of consciousness, whilst the "mentalists" will learn from nothing else. Again, some would reject experimental evidence in favour of "natural" observation; others reversely. Some think that nothing fundamental can be done by statistics, whereas others would rely on these alone. Some would put their faith in general impression; others, in definite observation. Most curious of all, perhaps, is the ban that has been laid by very many psychologists upon the use of the concepts of "purpose" and "motive".

Such taboos play an outstanding role throughout

history. Indeed, we have to thank them for the greater part of psychological literature. By them, in particular, have been earned the most revered niches in the temple of fame. One writer becomes classical by denying some fact that is obvious. Another achieves no less reputation by proving it again. And so the wheel goes round and round.

Apart from all such passing waves, the general tide of psychology seems to have arrived at conceiving the principle of mind, the " psyche ", as an Individual who Feels, Knows, and Acts ; who does so in a manner more or less well adapted to three intricately combining and often conflicting tasks ; those of preserving Himself, his Family, and his Society.

And so, after two thousand years of study, we might seem to come to a Mind which—save for the larger credit allowed to evolution—is disconcertingly similar to what it was originally supposed to be by common sense.

However, this result is not so stricken with poverty as it at first sight appears to be. The asserted lack of progress applies solely to the general outline of the adult human mental constitution. With respect to this bare outline, indeed, we do seem to have to admit that already pre-historic common sense had gone far : so far as to leave scant room for further progress.

But this bare outline is not everything. Indeed, the entire constitution of the mind is only one side of the subject-matter of psychology. There still remains to take into account its other side, that of *function*. And this, at any rate, claims to have made a tremendous advance ; nothing less than that of showing how the mental processes are governed by *laws*. One system of these aims at enunciating the sequences which govern *general* psychology. In another system, this time not of sequences but of coexistences, the domain approached is that of *individual* psychology. And large indeed would appear

to be the prospective application of these two systems of laws to such purposes as those of education, psychiatry, industry, art, ethics, religion, culture, linguistics, and anthropology. No less promising are the said laws for the psychology of children, and even that of animals.

To conclude, let us urge that this, like all other studies of the individual, cannot be more than provisional. Every actual observation finds him existing within some or other *environment*. Only for convenience of thought do we ever consider him without reference to this. And such isolation can never be more than temporary. The study of how a single man feels, knows, and acts can bring but little profit except in so far as it teaches how men feel, know, and act together, in their families and communities. Futile is the psychology that does not look forward to a sociology. Conversely, baseless is the latter when not founded on the former.

NOTES

PROLOGUE

P. 4. The histories alluded to are: *Geschichte der Psychologie* (Klemm); *History of Psychology* (Brett); *A History of Experimental Psychology* (Boring); *Hundred Years of Psychology* (Flugel).

CHAPTER I

§ 1, p. 12. See Tylor's *Primitive Culture*, 1871, p. 258.

§ 2, p. 17. For the fifth way of living Aristotle used the following terms almost synonymously: *νοῦς, νοεῖν, νόησις, γνώμη, τὸ διανοητικόν, λογισμός, φρονεῖν*. Among the commonest translations are: intellect, reason, understanding, thought.

p. 18. The passage of Bernard comes from *La Science expérimentale*, p. 212. That of Bayliss is from *Principles of General Physiology*. Preface to the second edition.

§ 3, p. 19. See Augustine's *Anima Utens Corpore*.

p. 19. Descartes writes that under the name of "penser" he includes "not only understanding, willing and imagining, but also feeling".

§ 4, p. 22. F. A. Lange, *Geschichte des Materialismus*, 1866.

CHAPTER II

§ 1, p. 28. Fries, *Handbuch der psychischen Anthropologie*, 1820.

p. 28. Beneke, *Lehrbuch der Psychologie*, 1845.

p. 30. Watson, *Psychology from the Standpoint of a Behaviorist*, 1919, Preface.

§ 2, p. 32. For Aristotle on the relation between mind and body, see especially his *De Anima*, A, ch. iii. For matter and form, see B, ch. i.

p. 33. For Descartes on body and mind, see his *Meditations*, vi. For his doctrine of spirits, see *Traité des passions*, Pt. I.

p. 35. Lotze, *Microcosmus*, Bk. III, ch. i.

p. 35. For Leibniz, see his Letter to Arnould, March 25th, 1690.

p. 36. For Spinoza on mind and body, see his *Ethics*, Pt. II.

p. 36. This "formalism" of Aristotle is more usually termed "hylomorphism".

p. 38. Berkeley: see his *Principles of Human Knowledge*, xxiii. For Kant, see *Kritik der reinen Vernunft*, 452 a–455 a. Brentano: see his *Psychologie vom empirischen Standpunkte*, 1874.

§ 3, p. 40. For Plato on smell, see his *Timaeus*, lxv-lxvii.

p. 41. The Greek φρήν seems to have been used both for the heart and the midriff. For its supposed mental functions, see Siebeck, *Geschichte der Psychologie*, Preface.

p. 43. For the cases of damage to volition by disorder of the brain, see Henderson and Gillespie, *Textbook of Psychiatry*, 1927, pp. 303 and 306.

p. 44. For influence of internal secretion, see Berman, *Glands regulating Personality*, 1928, p. 22.

p. 46. For Lashley, see "Basic Neural Mechanisms in Behavior", *Psych. Rev.* xxxvii, 1930. Also "Mass Action in Cerebral Function", *Science*, 1931.

§ 4, p. 46. For Theophrastus on mind and body, see his work on *The Senses*, § 1.

p. 47. For Aristotle on the organ of memory, see his *De Memoria*, 433 b.

p. 48. For v. Kries, see his *Ueber die materiellen Grundlagen der Bewusstseins-Erscheinungen*, 1901. For Head and Thompson, see their "Grouping of Afferent Impulses within the Spinal Cord", *Brain*, 1906.

p. 49. For Eckhartshansen, see his *La Nuée sur la sanctuaire*, 1819. For Robertson, Piéron, Moore and Gulliksen, see Chapter XXIX.

Upshot, p. 53. For Lashley, see *Psych. Rev.* xxxvii, 1930.

CHAPTER III

§ 1, p. 55. Frederick the Great: see his *Works*, vol. v, p. 220.

p. 55. Sergeant, *Solid Philosophy*, 1697, p. 8. For the older authors, see Diels, *Fragmente der Vorsokratiker*, 1903.

p. 59. For the "hormic" doctrine, see especially McDougall's *Outline of Psychology*, 1920, and Nunn's *Education, its Data and First Principles*, 1930.

§ 2, p. 62. Jeans is quoted from *The Mysterious Universe*, 1932; Eddington, from *Nature of the Physical World*, 1930.

§ 3, p. 65. What the modern physicists really found to be constant and then entitled "energy" was, as is well known, nothing more than $\frac{1}{2}mv^2$.

§ 4, p. 69. Compare the still earlier "*Omnia unitatem appetunt*" of Avicembron. Similar remarks, indeed, were already made by Augustine, and even by Plotinus.

p. 68. Aristotle is quoted from his *Metaphysics*.

§ 5, p. 71. For Aristotle's σύνολον, see his *De Anima*, 412 a, 2. *Forma* seems to have been restricted to spatial shape as late as classical Latin: *de forma novi, de colore non queo novisse*. On the other hand, "shape" itself was eventually generalized, as in the well-known line: "Thou comest in such a questionable shape". Aquinas is quoted from his *Summ. Theol.* Pt. T, Q. lxxvi. The following example seems to indicate that *forma* was sometimes used to denote appearance in classical Latin: *Formam adhuc habetis . . . et speciem tyrannorum.*

CHAPTER IV

§ 1, p. 79. For Kant, see his *Anthropologie*, 1800, § 7. For Comte, see his *Cours de philosophie positive*, 1830, i, 35-36. For Sextus Empiricus, see especially his *Adversus Mathematicos*.

p. 80. For Beneke, see *Lehrbuch d. Psychologie*, § 129.

p. 81. Among the commonest synonyms for " introspection " have been : " inner sense ", " internal perception ", " consciousness ", " self-consciousness ", " self-observation ", " attention to one's own mental states ", " the mind taking notice of its own operations ". Introspective technique includes such precautions as the following: instant record, so as to exclude the omissions and distortions involved in recall ; elaborate verification by comparison between different persons, and between the same person on different occasions ; skilful elimination of artificial attitudes induced by the very effort to introspect.

§ 2, p. 83. Schelling is quoted from his *Phil. Br. über Dogmatismus u. Kritizismus*, 1796.

p. 84. For Bacon, see his *Novum Organum Scientiarum*, 1612.

p. 86. To understand the Titchenerian psychology, special reference may be made to his own *Retrospect* (*Am. J. Psych.* xxxvi, 1925), to his obituary by his pupil Boring (*Am. J. Psych.* xxxviii, 1927), and to the *Psychological Theories of Those Whose Training Background was the Structuralism of E. B. Titchener* (*Psychologies of 1930*). Further light may be obtained from the *Major Categories of Psychology* by Bentley (*Psych. Rev.* xxxiii, 1926), and the *Outline of a Psychological Standpoint*, by Warren (*Am. J. Psych.* xxxix, 1927.)

§ 4, p. 87. For Sigwart, see his *Logik*, 2nd ed., ii, p. 561.

p. 88. Collins and Drever : *Experimental Psychology*, 1926.

§ 5, p. 89. For Fries, see his *Handbuch d. psych. Anthropologie*, 1832.

p. 90. Some notion of Herbart's " mechanics " can be gained from the following account : Suppose that two ideas strive to arise in consciousness at the same time with the respective intensities a and b. They will interfere with one another, Herbart said, by the amount of the lesser intensity, say b. The amount of total loss will be divided between the two intensities in such a way that the a loses the share $\frac{b^2}{a+b}$ whilst b loses $\frac{ab}{a+b}$. Upon this simple basis were built prodigious complications. See his *Psychologie als Wissenschaft*, 1824.

§ 7, p. 94. Among the most interesting recent contributions to the topic of hypothesis may be mentioned McDougall's *Frontiers of Psychology*, 1934, and Claparède's *Génèse de l'hypothèse*, 1934 [*Archives de psychol.* xxiv].

§ 8, p. 95. James Mill: *Analysis of the Human Mind*, 1829, i, p. 1.

p. 96. For Petermann, see his *Gestalt Theory*, 1932. For Thompson, see *Philosophy of Necessity*, 1841. For Lewes, see *Problems of Life and Mind, Problem I, Study of Psychology*, ch. xi.

p. 97. Stratton, *Psych. Rev.* xvi. Fröbes, *Lehrbuch d. exper. Psychol.* i, p. 21. On some of the fallacies besetting psychological analysis, see Brett's *History of Psychology*, ii, p. 306. On the ambiguity of the very word analysis, see Hamilton's Lectures, Lect. XXXVII.

p. 98. For Aristotle, see his *De Anima*, Bk. I, ch. i, 402 b.
For Ach, see his *Analyse des Willens*, 1935.

p. 100. Janet: *Médications psychologiques*, 1919, ii, p. 216. Brown: *Mind and Personality*, 1926, pp. 8-11.

CHAPTER V

§ 1, p. 106. Gorgias is quoted from Sextus Empiricus, *Adversus Mathematicos*, vii, 65-87.

§ 2, p. 107. Plato is quoted from his *Republic*, Bk. IV, ch. xiii, 436 A, transl. Davis, p. 120.

p. 107. In particular, "potentia" was used by Aquinas. For "*virtutes*", see for instance Bellunen's Latin translation of Avicenna's *Compendium de Anima*. For "*vires*" and "*aptitudines*", see Casmann's *Psychologia anthropologica*, 1594. The English usage of "ability" seems to have been little followed by the cognate Latin and French words, "*habilitas*" and "*habilité*".

p. 108. The passage about Buddhi is taken from the *Vedanta-Sutras*, ii, A D Hyaya, Pada, 31.

p. 109. For what we are here calling "intellect", Pythagoras and others seem to have used the word φρήν, see notes on Chapter II, § 3. Plato's terminology was much the same as that of Aristotle, see notes on Chapter I, § 2. Both generally employed νοῦς for the power and νόησις for its actual exercise. By σοφία they denoted the virtue of possessing the νοῦς, corresponding thereby to the English "wisdom". The Latin translation of νοῦς was "*intellectus*", whence our "intellect". (The word *had* meant (with Cicero) sensory discrimination. Literally, it means "I pick out".) Occasional allied terms were "mens" (Aquinas, *Summ. Theol.* I, Q. lxxix, Art. 1. 1), and "ratio" (*ibidem* also Q. xvi, Art. 3. 3); see also his *In commento super Dionysium de divinis Nominibus*, lect. 5, prin. Subsequently, *ratio* and its translation (reason, *raison*) became more general. But the objection has been made that this word ought to have a more limited meaning (*La raison est l'intelligence considérée comme pouvoir de raisonner*, Mercier's *Psychologie*, i, 279). Among other terms that have been used—rather arbitrarily—in a similar signification are "under-

standing" and "thought". One of these terms, viz. λόγος, has been historically developed into a symbol with very pregnant and partly hypostatical significance, as has been shown in the admirable work of A. Aall, *Der Logos*, 1896 and 1899.

§ 3, p. 109. The word *Manas* seems to have had several other meanings.

p. 109. We read about the Buddhi or Intellect: "Beyond the Senses there are the Objects; beyond the Objects there is the Mind; beyond the Mind there is the Intellect" (*Sacred Books of the East*, vol. xxxiv, ch. xxviii). For the Western philosophy before Parmenides we have had to rely chiefly on *Doxographi Graeci*, 278; Stobaeus, *Eclog.* i, 41, 846 ff. For Parmenides himself, we have followed the account given by Plato.

p. 109. As regards the ancient conception of timelessness, compare the Hebrew passage: "Thus shalt thou say unto the people of Israel, I AM hath sent me" [Exod. iii. 14].

p. 110. For Heraclitus, see Diel's *Fragmente*, 107. The translation of the λόγος of Heraclitus as "intellectual law" has been questioned.

p. 110. For Democritus, see Stobaeus, *Floril*, ed. Mein, iv, p. 233.

p. 110. For reference to λόγος of Anaxagoras, see Aristotle, *Phys.* iii, 4, 203 a 30.

p. 110. Exactly how much Plato owed to his predecessors, especially Socrates and the Syracusan poet, Epicharmus, is now hard to decide (see Diogenes Laertius, Bk. III, ch. xiii), but his debts to Pythagoras, Parmenides, and Heraclitus are obvious enough. The present account of his doctrine is taken from his *Republic*, Bk. VII, ch. i. For Aristotle, see his *De Anima*, Bk. II, ch. iii.

§ 4, p. 111. For references to Plato, see his *Timaeus*, 52 A [trans. Davis].

§ 5, p. 112. *Universus* clearly derives from *unus* (one) and *verto* (I turn).

p. 112. Plato writes that "real being has for its form sameness" [τὸ κατὰ ταὐτὰ εἶδος ἔχον], *Timaeus*, 52 A, this translation being due to the kindness of Mr. Whittaker.

p. 112. For Aristotle, see his *De Interpretatione*, ch. vii; *Posterior Analytics*, Bk. I, chs. i and iv; Bk. II, ch. xix.

§ 7, p. 114. Plotinus, *Ennead.* IV, Bk. III; also V, Bk. IX; Galen, *De optimo docendi genere*, C 4, vol. v, 48; Augustine, *De Trinit.* xi, 11, 18; Gregory of Nyssa, *De opif. hom.*, 14 ff.; Aquinas, *Summ. Theol.* m. I; Hugo de St. Victor, *Erud. didasc.* i. 4; Avicenna, *Compendium de Anima*, chs. vii and viii. Also Averroes; Maimonides, *Guide of the Erring*; Occam, *Quodlibeta*, i, Q. xviii. Aquinas, *De Unitate intellectus contra Averroistas.*

p. 115. It is perhaps needless to remark that the French term *spiritualist* does not denote in French the believers in communication with the souls of the dead ("spiritist"). Vico holds that "Our thoughts are the thoughts of God within us". See Flint's *Vico*, 1884, p. 130. Cf. the Stoic doctrine of

ὁ θεῖος λόγος, see A. Aall, *Der Logos*, i, 148, 162, 199; ii, 263, 325.

§ 7, p. 119. Aquinas, *Summ. Theol.*, I, Q. 79, Art. 11.

p. 121. The illustration of "brains" is borrowed with kind permission of the Proprietors of *Punch*.

CHAPTER VI

§ 2, p. 124. Spencer writes as follows: "When any state *a* occurs, the tendency of some other state *d* to follow it, must be strong or weak according to the degree of persistence with which A and D (the objects or attributes that produce *a* and *d*) occur together in the environment. If, in the environment, there is a more persistent occurrence of A with B than of A with D; then, the maintenance of the correspondence implies that when *a* arises in consciousness, *b* shall follow rather than *d*. These are manifest requisites. If the strengths of the connexions between the internal states are not proportionate to the persistences of the relations between the answering external agents, there will be a failure of the correspondence—the inner order will disagree with the outer order" (*Principles of Psychology*, 1870, pp. 408-9).

p. 124. Bergson's doctrine may be interestingly compared with the scholastic view that the Intellect cannot know the individual.

§ 3, p. 125. Galton is quoted from his *Inquiry into the Human Faculties*, 1883.

p. 126. Ebbinghaus, *Zeit. f. Psych.*, 1897, pp. 401-459.

p. 127. Almost all Binet's fundamental work on ability has appeared in his journal, *Année Psychologique*. But as regards dates, the real publication is always a year later than the date given in the title. For instance, the number entitled *Année Psychologique*, 1905, did not really appear till 1906.

p. 128. Most of the modern definitions of "intelligence" are given in the Symposium in America, *Journal of Educational Psychology*, xii, 1921.

CHAPTER VII

§ 1, pp. 133-40. The works quoted in this section are as follows: Titchener, *The Psychology of Feeling and Attention*, 1908, p. 171; and *Textbook of Psychology*, 1911, § 75; Wolff, *Psychologie Empirica*, 1738, Pt. I, sec. iii, ch. i, § 236; Shand, "Analysis of Attention", *Mind*, N.S., vol. iii, 1894, pp. 455, 460; Condillac, *Extrait raisonnée du traité des sensations*, pub. with the *Traité*, 1788, p. 211; Herbart, *Psychologie als Wissenschaft*, 1824, ii, § 128; Fechner, *Psychophysik*, 1859, ii, sec. xli; G. E. Müller, *Theorie der sinnlichen Aufmerksamkeit*, 1873; Carpenter, *Mental Physiology*, 1874, ch. i, p. 25; Bradley, "Is there any Special Activity in Attention?" *Mind*, xi, 1886, p. 300; Messer, *Empfindung und Denken*, 1908, p.

120; Read, *Metaphysics of Nature*, 2nd ed., 1908, ch. x, p. 199; Ward, "Psychology", art. *Encycl. Britannica*, 1911, p. 552; Ebbinghaus, *Grundzüge der Psychologie*, 1905, Bk. IV, ch. i, § 56; Dürr, *Die Lehre v. d. Aufmerksamkeit*, 1907, sec. 2, p. 12; McDougall, "Physiological Factors of Attention", *Mind*, xi, N.S., 1902, p. 316; Yerkes, *Introduction to Psychology*, Pt. IV, ch. xxii, p. 293; Beneke, *Lehrbuch der Psychologie*, 1845, § 66; Fortlage, *System der Psychologie als empirische Wissenschaft*, 1855, p. 103; Porter, *The Human Intellect*, 1868, § 54, p. 69; Maudsley, *The Physiology of the Mind*, 1876, pp. 313-14; Th. Lipps, *Leitfaden z. Psychologie*, 1906, Abschn, II, ch. v, p. 60; Baldwin, *Handbook of Psychology*, 1890, Pt. I, ch. v, § 1; Maher, *Psychology*, 1911, Bk. I, Pt. II, ch. xii, p. 232; Geyser, *Lehrbuch der allgemeinen Psychologie*, 1908, § 274; Lotze, *Outlines of Psychology*, 1884 (trans. Ladd), Pt. III, § 26; Hickok, *Rational Psychology*, 1849, Bk. II, Pt. I, p. 115; Morell, *An Introduction to Mental Philosophy*, 1862, Pt. II, ch. ii, p. 86; Ulrici, *Leib u. Seele*, Pt. I, sec. 246; Pt. II, sec. 27; Ladd and Woodworth, *Elements of Physiological Psychology*, 1911, Pt. II, ch. ix, § 4; Bergson, *Matière et mémoire*, 1896, ch. ii; Ueberhorst, *Arch. f. system. Philosophie*, iv, 1898, p. 76; Dawes Hicks, "The Nature and Development of Attention", *Brit. J. Psych.* vi, 1913, p. 13; Höfler, *Psychologie*, 1897, p. 263; Oppenheimer, *Phys. d. Gef.* p. 103; Volkmann, *Lehrb. d. Psych.*, 2nd ed., vol. ii, § 104; Cornelius, *Einl. in d. Philos.*, 1903, § 23, p. 218; Thurot, *De l'entendement et de la raison*, 1833, Pt. I, sec. iii, ch. ii; Malebranche, *De la recherche de la vérité*, 1674, Bk. VI, Pt. I, ch. ii; Lloyd Morgan, *Introduction to Comparative Psychology*, 1894, p. 189; Huxley, *Hume*, 1879, ch. iv, p. 92; Stout, *Manual of Psychology*, 1913, Bk. I, ch. ii, § 1; Ehrenfels, *System der Werttheorie*, 1897, § 81, pp. 253 ff.; Reid, *Essays on the Intellectual Powers*, 1785, Ess. I, ch. v; Stewart, *Philos. of the Human Mind*, 1843, Pt. I, ch. ii, p. 65; Kant, *Anthropologie*, 1800, § 3; Maine de Biran, *Œuvres inédites*, II, ch. xxx; Jouffroy, "Mélanges philosophiques", 1833, *Psychologie*, v. p. 262; Thorndike, *Elements of Psychology*, 1907, Pt. I, ch. vii, § 19; Calò, *La Psicologia dell' attenzione*, 1907, ch. i, pp. 9 ff.; Angell, *Psychology*, 1908, ch. iv; Wundt, *Physiologische Psychologie*, 6th ed., 1908, vol. iii, ch. xviii, p. 315; Wirth, "Zur Messung der Klarheitsgrade der Bewusstseinsinhalte", *Psych. Stud.* v, p. 48; Schuppe, *Grundriss der Erkenntnis-Theorie*, 1894, p. 143; Biervliet, *Esquisse d'une éducation de l'attention*, 1912, ch. i, p. 8; Marshall, *Consciousness*, 1909, Bk. II, Pt. II, dev. i, ch. xiii, p. 314; Calkins, *A first Book in Psychology*, 1910, ch. v, sec. i, p. 94; Croom Robertson, *Elements of Psychology*, pub. 1896, lect. xxii, p. 149; Stumpf, *Tonpsychologie*,

1890, ii, p. 279; Rignano, *Monist*, xxii, 1912, p. 7; Ziehen, *Leitfaden der physiologischen Psychologie*, 1911, lect. iii, p. 44; Judd, *Psychology*, 1907, ch. vii, p. 193; Haben, *Mental Philosophy*, 1857, div. i, ch. ii, pp. 46-7; Holland, *Mental Physiology*, 1858, p. 81; James, *Principles of Psychology*, 1891, I, ch. xi, p. 403; Külpe, *Grundriss der Psychologie*, 1893, p. 438; Ebbinghaus, *Grundzüge der Psychologie*, 1905, Bk. IV, ch. i, § 58, p. 61; Vaschide and Meunier, *La Pathologie de l'attention*, 1908, p. 1; Geyser, *Lehrbuch der allgemeinen Psychologie*, 1908, § 269; Foucault, "Sur l'exercise dans le travail mental", *Année Psychologique*, xx, 1915, p. 125.

§ 1, p. 137. Among other authors whose views resembled that of Kant are the following: Jakob, *Grundriss der Erfahrungs-Seelenlehre*, 1810, Abth. I, § 272; Schopenhauer, *Die Walt als Wille u. Vorstellung*, 1818, vol. ii, ch. xxx; Bolzano, *Wissenschaftslehre*, 1837; Cousin, *Philosophie sensualiste*, 1859, pp. 80-81; Haven, *Mental Philosophy*, 1857, Div. I, ch. ii, pp. 46-7; Mansel, *Metaphysics*, 1875, p. 133; Renouvier, *La Nouv. Monodologie*, 1899, Pt. II, xlii, p. 97; Preyer, *Die Seele des Kindes*, 1884, ch. xiii; Wahle, *Das Ganze der Philosophie*, 1896, p. 372; Kreibig, *Die intellektuellen Funktionen*, 1909, p. 7.

This sensory view of activity was specially emphasised by Fechner, *Elemente der Psychophysik*, 1860, xliv, pp. 475, 490. See also Ribot, *Psychologie de l'attention*, 4th ed., 1898, pp. 95 ff.; Ferrier, *Functions of the Brain*, ch. xiii, secs. 17-19; James, *The Feeling of Effort*, 1880.

p. 138. The following are among the authors who have specially connected attention with "activity": Laromiguière, *Leçons de philosophie*, 1811–12, Pt. I, leçon vii, p. 134; Cousin, *Philosophie sensualiste*, 1859, pp. 80-81; Ulrici, *Leib u. Seele*, 1874; Porter, *Human Intellect*, 1872, Pt. I, prelim. ch., § 53, p. 69; Rosmini, *Psychology*, 1884, Pt. II, Bk. II, ch. viii, § 1023, 158-9; Paul Janet, *Principles de métaphysique et de psychologie*, 1897, lect. vii; Ward, "Psychology", art. *Encycl. Britann.*, 1911, p. 552; Sully, *Human Mind*, 1891, Pt. II, ch. vi, p. 142; Ladd, *Outlines of Descriptive Psychology*, 1898, ch. iii, p. 44; Maher, *Psychology*, 1911, p. 232; Ch. Mercier, *Psychology, Normal and Morbid*, 1901, p. 284; Baldwin, *Handbook of Psychology*, 1890, Pt. I, ch. v, § 1; Pillsbury, *Attention*, 1908, p. 217; Wirth, "Zur Messung d. Klarheitsgrade der Bewusstseinsinhalte", *Psych. Stud.*, V, 1909; Angell, *Psychology*, 1908, ch. iv, p. 82.

p. 139. Not unlike the view of Calkins was that of Lewes, *Problems of Life and Mind*, 2nd Series, 1877, 2nd Problem, ch. iv, p. 357.

p. 140. With the view of Foucault may be compared that of Lehmann, *Grundzüge der Psycho-Physiologie*, 1912, Bk. III, ch. lii, p. 204.

§ 2, p. 141. Plato appears never to use προσέχειν with γνώμη or with διάνοια, but other authors do so. The substantive, ἡ πρόσεξις τοῦ νοῦ, is only used by him once, if we exclude the Definitions (413 D) as spurious.

The following are some instances of the early Latin usage of *animus*: *Vestrum animum adhiberi volo*, Plautus, *Stichus*, 103, 200 B.C. *Animum adverte ut aeque mecum haec scias*, Plautus, *Asinaria*, 332, 184 B.C. *Ad virginem animum adjecit*, Terentius, *Eunuchus*, 143, 161 B.C. *Quaeso animum attendete*, Terentius, *Andria*, 8, 166 B.C.

The only case in which I have found such a phrase referring to sensation is *Attendi enim oculos aut animum subauditur*, Terentius, *Becyra*, 2, 2, 23, 265 B.C.

Sometimes *animo* is substituted, as *Mea Causa, aequo animo attendete*, Terentius, *ibidem*, 28. *Cum animo attendi ad quaerendum quid siet*, Pacuvius, *Trag.* 18, 154 B.C.

The earlier distinction of *animus* from *anima* is well shown in the following passage: *sapimus animo, fruimur anima*, Accius, *Trag. Frag.*, 90 A.D. Upon occasion, however, it could have several other significations; it might embrace all the vital functions, as in *Crura ac pedes nostri sed ab animo movetur*, Varro, *Men.* 32, 27 B.C. Or it might be equivalent to desire, as seems to occur in *Illud animus meus miretur*, Plaut. *Rud.* 614. Or again, it might mean affective states, as may be the case in *Quid si hic animus accupatust, mater, quid, faciam?* Plaut. *Asin.* 537.

Anima also had different significations, of which the chief were: spirit (*animam comprime*, Plaut., *Amph.*, frag. 14); air; life; and as synonymous with *animus*.

With the Schoolmen *animus* extended its meaning to the whole psyche, as opposed to *anima* which denoted only the "soul".

The word *intentio* (with its cognates) has a psychologically important history of its own. Originally, *intendere* scarcely differed from *attendere*, as may be seen in the following definition: *Intendo: Proprie est idem quod tendo, aut valde tendo. Attendo: Proprie est aliquid valde tendo, aut ad aliquid tendo* (*Porcellini totius Latinitatis Lexicon*).

The grammarian Nonium Marcellus (2-4 century B.C. ?) simply identifies the two. *Adtendere est intendere* (*De varia significatione sermonis*, 238).

But it would appear that the *ad-* differs somewhat from the in- by giving rather more emphasis to the notion of "towards". To this must be added that the compounds of the *in-* have a far wider range; although *intentio* is sometimes used almost synonymously with *attentio*, it also possessed many quite different meanings, as tension, increase of tension, accusation, logical premise, and scope, to which must be added the important group of meanings which will concern us later on. Perhaps the rarest ancient usage of

the word is precisely its modern almost exclusive one, " purpose ".

In allusion to the τόνος Cicero writes: *Mens, quae sensuum fons est, naturalem vim habet, quam intendit ad ea quibus movetur* (*Acad.* xi, 1).

§ 2, p. 143. For Philoponus, see his *De Anima*, Bk. III, ch. ii. For Ephesius and Psellus respectively, see *Commentarii Collegii Conimbricensis*, 1603, Bk. III, ch. ii, Q. i, art. 2, and *De Omnifaria Doctrina*, § 46.

The usage of Aquinas was set forth as follows: *Sed in aliis exterioribus actibus plurimum noceret, si actualis intentio semper adesset: quia optimus citharaedus pessimus redderetur, ut Avicenna dicit. Ergo nocet attentio, si continue adsit orationi. Praeterea, non potest mens humana ad plura simul intenta esse* (*Quartum Scriptum Sentiarum*, Dist. xv, Q. iv, art. 2, Quaestunc. 5, Sol. iv.

In the time of Aquinas *animus* seems to have no longer been confined to intellect but to have included passion. This is shown when, after quoting Aristotle's view *quod in sensitivo appetitu est desiderium et animus*, he adds in explanation: *id est concupiscibilis et irascibilis* (*Summ. Theol. Secunda Secundae*, Q. cxxix, art. 1).

See also *Utrum intentio sit actua* . . . (*ibidem*, I, Q. xii, art. 1).

The usage of *attentio* by Vives is particularly interesting. He is almost lavish with the term in the following incidental usage. *Quum vero audiunt, celeritas sermonis praecurrit attentioni. Quo sit, ut intellectio perturbatur, quo de genere sunt ii potissimum, qui ex lectione didicerunt magis linguam, quam audiendo. Vehementius autem admirare, si videas qui quod loqui sciant, loquentibusque; aliis facile intelligant, idem illud eos fallere si legant. hi sunt ad attentionem segnes. quibus loquentibus, vel audientibus, calor ille orationis excitat attentionem. versis autem ad legandum et refrigeratis, remittitur attentio* (*De Anima*, 1561, ii, p. 87). Nevertheless, as soon as he begins to discuss the number of different fundamental powers, this " attention " is rigorously ignored again.

p. 144. The first rule of Descartes in seeking truth ran as follows: " *de ne comprendre rien de plus en mes jugements que ce qui se présenterait si clairement et si distinctement à mon esprit que je n'eusse aucune occasion de le mettre en doute* " (*Discours de la méthode*, ii).

For earlier reference, see Sextus Empiricus, *Adv. Math.* vii, and Diogenes Laertius, Bk. X. Some of the earlier Stoics, however, admitted " right reasoning " as a criterion of truth; see Diog. Laert. Bk. VII, 37.

p. 144. For Malebranche and Leibniz, see respectively: *De la recherche de la vérité*, 1674, Bk. VI, Pt. I, ch. ii, and *Nouveaux Essais*, Avant-propos, and Bk. II, ch. ix.

CHAPTER VIII

§ 1, p. 148. Alternative words that have been used instead of "sensism" are "sensualism", "sensationism", and "sensationalism". But no particular advantage appears to derive from the extra syllables.

In any case, the word embraces several distinct doctrines. Metaphysically, it may be said with Kant that the "sensual philosophers" are those who teach that "all reality lies in the objects of the senses; all the rest is imaginary". The psychological doctrine, on the other hand, is that which would completely explain all cognition, both its material and its form, by means of sensory perception and the remembrance of it. Of course, only the psychological doctrine concerns us here.

p. 149. See F. M. Müller, *The Six Systems of Indian Philosophy*, 1899, pp. 100 ff. For the older doctrines of the elements, see Aristotle, *De Anima*, Bk. III, ch. iii, 427 a; *Metaphys.* Bk. III, ch. v. See also Theophrastus, *de Sens.*, 10 ff.

p. 150. Protagoras is credited with saying: ἀληθὴς ἄρα ἐμοὶ ἡ ἐμὴ αἴσθησις (Plato, *Theaet.* 160 C); Aristippus: τά τε πάθη καταληπτά (Diog. Laert. Bk. II); Epicurus: 'Επίκουρος πᾶσαν αἴσθησιν καὶ πᾶσαν φαντασίαν ἀληθῆ (*Stobaei Ecl.* i, 50(42); *Plutarchi Epit.* iv, 8. 9. See also Cicero, *Academica*, ii, 24; and Sextus Empir., *adv. Math.*, vii, 210; viii, 9; Pyrrho: Diog. Laert. Bk. IX; Lucretius: *De rerum natura*, Bk. IV, ver. 380-469. About the Stoics, see Cicero, *Academica*, II, 24; also Diog. Laert. Bk. VII, 36. We only learn of the Nominalists through their opponents, Abelard, Anselm (*De fide Trin.* ch. 2), and John of Salisbury. About the Stoics, see the *De Placitis Philosophorum*, formerly attributed to Plutarch, Bk. IV, ch. xi. The statement about Condillac is taken from Jouffroy, *Œuvres de Reid*, 1828, vol. iii, p. 300.

p. 150. Among prominent sensists were Holbach, Helvetius, and Lamettrie in France; Rüdiger and Weishaupt in Germany; Romagnosi, Soavi, and Borelli in Italy.

p. 151. Noted French spiritualists were Laromiguière, Royer Collard, Maine de Biran, Cousin, and Jouffroy. The nineteenth-century materialists included in France Cabanis and Taine; in Germany, Feuerbach, Moleschott, Czolbe, Knapp, and Avenarius.

p. 151. On the question as to whether the lines quoted were really written by Epicharmus, see Hamilton's note in his ed. of Reid, 1863, ii, p. 879.

p. 152. For Plato, see *Theaetetus*, 185 C, and *Republic*, 513 D; for Aristotle, *Problemata*, sec. xi, § 33; and for Strato, Plutarch, *De Sollertia Animalium*, iii, 6.

p. 152. Thus, the Stoic Zeno compared simple sensation to an extended

finger ; assent (as being the first activity of pure judgment), to the closed hand ; conception, to the fist ; and knowledge, to one fist firmly grasped by the other. Cicero, *Acad.* ii, 47.

§ 1, p. 152. For Tertullian, Plotinus, and Lactantius, see respectively *De Anima*, ch. xviii ; *Ennead*, III, Bk. VI, ch. i ; IV, Bk. II, ch. xxvi ; IV, Bk. VI, ch. ii ; *De Opificio Dei, vel Formatione Hominis*, ch. ix.

p. 152. de Raei writes : " *Sed quia ita facti sumus a natura, ut proprias hasce sensuum perceptiones etiam aliae comitentur, quibus magnitudines, figuras, situm, distantiam, motum ac quietum, quae vocantur objecta communia, nec non substantiam quandam corpoream una cum mutationibus, effectis et agendi viribus jam ineunte aetate concepimus, horum onmium notitiam* (*quae accurate loquendo intellectus et rationis est propria*) *ad sensum etiam referre solemus* " (*Clavis Philosophiae Naturalis*, p. 35).

p. 152. For Aquinas, see his *Summ. Theol.* I, Q. lxxviii, art. 3 ; for Bovillus, " Nihil est in sensu, quin prius fuerit in intellectu ", *De Intell.* C. 9, § 3 ; for Malebranche, *De la recherche de la vérité*, 1674, Bk. VI, Pt. II, ch. ii ; for Hegel, *Enzyklop.*, *Einleitung*, § 8 ; for Hamilton, his edition of Reid, note D, 11 ; for Fichte, *Psychologie*, 1864, vol. i, p. 261 ; for Maher, *Psychology*, 1911, p. 232.

§ 3, p. 153. For scholastic anticipation of the sensist aphorism, see especially Aquinas, *Quaestiones de Veritate*, ii, art. iii, 19 (but, for metaphysical reasons, he replaces the *fuerit* by *sit*). He even says that " sensible perception produces the universal ", *Summ. Theol.* I, Q. lxxxiv, art. 4, in corp.

p. 153. For Aristotle, see *Analytica Post.* Bk. II, ch. xix. For the Stoics, see the following : ἐπιστήμην μεν εἶναι τὴν ἀσφαλῆ καὶ ἀμετάπτωτον ὑπὸ λόγου κατάληψιν, Stob, *Ecl.* ii, 128. ἡ δε ἐπιστήμη πῶς ἡγεμονικόν ἔστιν, *Galein Histor. Philos.*, 13 ; *Epicteti Diss.* I, 1, 1-17 ; Aurelius, *In se ips.* iii, 16. For Epicurus, see *Plutarchi Epit.* iv, 4.

p. 154. Campanella writes : " *Erra grandemente Aristotele asserendo che il senso guidica ; la mente sola è che guidica con l' esercizio della sua attività* " (*Op. di T. Campanella*, Alessan. d'Ancona, 1854, i, p. xlv).

p. 154. For Locke, see his *Human Underst.* Bk. II, ch. xi, Bk. I, ch. i, and Bk. IV, ch. ii. He fails to distinguish " innate " from " connate ".

CHAPTER IX

§ 1, p. 159. Aristotle wrote μετὰ χρόνου πᾶσα μνήμη, *De Anima*, Bk. III, ch. vi, 430 b (translation by Wallace). See, too, his *De Memoria*, 450 a, 450 b, and 451 a, 17.

p. 159. Plotinus is quoted from the *Enneads*, IV, Bk. VI, ii. For Avicenna, see Conimbricenses, *De Memoria et Reminiscentia*, 1631, ch. i, p. 2.

§ 1, pp. 160-61. Augustine, *Confessiones*, Bk. X, ch. xiii ff.; Reid, *Essays on the Intellectual Powers*, 1785, Essay iii, ch. i; Hamilton, *Metaphysics*, 1865, ii, p. 212; James, *Principles of Psychology*, 1891, i, p. 480; Bergson, *Matière et mémoire*, 1896, p. 76.

p. 162. Aristotle, *De Memoria*, 451 a.

§ 2, p. 163. Boethius, *De Cons.* v. For Fortlage, see *Acht psychologische Vorträge*, 1872, Vort. III, p. 94.

p. 164. Among those who in former times appear to have kept the creative imagination (or any of its synonyms) distinct from memory are the following: Galen, *Opera*; Cardanus, *De Subtil.* xiv. 583; William of Conches, see Haurian, *De la Philos. Schol.* i, p. 445; Abelard, *Tractatus de Intellectibus*; Bonaventura, *Itin. ment. ad Deum* 1, 2 dist. 24, 2. Among authors since the Renaissance are the following: Bacon, *Instauratio Magna, De Augmentis*, 1623, Bk. II, ch. i; *De Dign.* IV, iii; Leibniz, *Nouveaux Essais*, 1765, Bk. IV, § 3; Wolf, *Psychologia Empirica*, 1738, Pt. I, sec. i, ch. 3, 4; Reid, *Essays on the Intell. Powers*, 1785; Stewart, *Philosophy of the Human Mind*, Pt. I, 1792; Schulze, *Psychische Anthropologie*, 1819; Eschenmayer, "Die Phantasie ist das Schaffende und Zeugende", *Psychologie*, 1822, p. 108; Reichlin-Meldegg, *Psychologie des Menschen*, 1838; Garnier, *La Psychologie et la phrénologie*, 1839; Burdach, *Blicke ins Leben*, 1842, i, p. 159; Hamilton, *Metaphysics*, 1859–61, vol. ii, p. 13; Despines, *Psychologie naturelle*, 1868, ch. i; Rabier, *Psychologie*, 1888.

CHAPTER X

§ 2, p. 170. Plato is quoted from his *Phaedrus*.

§ 4, p. 172. Aquinas is quoted from his *Summ. Theol.* Pt. I, Q. lxxx, art. 2, and Q. lxxxi, art. 1; also Pt. I, Q. xi, art. 1.

§ 5, p. 175. Jordan, *Character as seen in Body and Parentage*, 1890.

§ 6, p. 177. Malebranche, *De la recherche de la vérité*, Bk. IV, ch. i.

§ 7, p. 181. Descartes, *Passions de l'âme*, Pt. I, art. 1, and Pt. II, art. 69; Malebranche, *De la recherche de la vérité*, ch. iii, p. 386; Shand, *Foundations of Character*, Bk. I, ch. iii.

CHAPTER XI

§ 1, p. 185. C. A. Hart is quoted from his *Thomistic Concept of Mental Faculty*, 1930, p. 1.

§ 2, p. 186. Sully, *Outlines of Psychology*, 1884, 1892, pp. 25-6.

§ 4, p. 187. Locke, *Human Underst.*, 1689, Bk. II, ch. xxi; Malebranche, *De la recherche de la vérité*, 1674, Bk. VI, Pt. II, ch. ii; Hume, *Treatise of Human Nature*, 1739, Bk. I, Pt. IV, sec. iii; Herbart, *Lehrb. z. Psychologie*, 1816, Introd.; Volkmann, *Lehrb. d. Psychologie*, 1875, Introd. § 4; Erdmann, *Psychologische Briefe*, 1856, p. 259. Among other authors with similar views are: Drobisch, *Empirische Psychologie*,

§ 137; C. Carus, *Psyche*, 1851, p. 282; Lamettrie, *L'Homme machine*, 1748, pp. 67-8.

§ 4, p. 189. Albertus Magnus, for example, writes: "*Animae potentiae sunt proprietates consequentes esse et substantiam animae*" (*Summ. Theol.* Pt. I, Q. xv, art. 2). Renouvier and Prat speak of the diverse intellectual functions as "*propriétés de l'âme*" (*La Nouvelle Monodologie*, 1899, Pt. III, xlii). Compare Cicero: "*Facultates sunt, aut quibus facilius aliquid fit, aut sine quibus omnino confici non potest*" (*De Inventione*, Bk. I, ch. xxvii, § 41). The word is even applied to inanimate things, as in "*Si res facultatem habitura videatur ut . . .*" (*Epist. ad Fam.* Bk. I, epist. 7, § 4). Vico writes: "*Facultas dicta quasi faculitas; nude postea facilitas quasi sit expedita, seu exprompta faciendi solertia. Igitur ea est facilitas qua virtus in actum deducitur. Anima virtus est; visio actus; sensus videndi facultas*" (*De antiquissima Italorum sapientia*, 1710, ch. vii, p. 97). For Rosmini, Wolff, and Aristotle, see respectively: *Psicologia*, 1848, Pt. II, Bk. I, ch. xi; *Psichologia empirica*, 1738, Pt. I, sec. ii, ch. i, § 29; *Metaphys.* Bk. IV, ch. xii.

§ 5, p. 189. Aristotle, *De Anima*, Bk. II, ch. ii, 413 b. Augustine says of Memory, Understanding, and Will, that "These three are one, one life, one mind, one essence" (*De Trin.* Bk. I, ch. ii). For the Arab view, see Alfarabi, Avempace, Averroes, and Avicenna. So, too, Aquinas: "*Unius rei est unum substantiale, sed possunt esse operationes plures*" (*Summ. Theol.* Pt. I, Q. lxxvii, art. 2. See also Plotinus, *Ennead*, ii, 9, 2. For Wolff, see his *Psychologia Rationalis*, §§ 81-2.

§ 6, p. 190. Herbart, *Lehrb. z. Psychologie*, Pt. I, sec. i, ch. iii. For Fries and Kant, see respectively: *Handbuch der psychischen Anthropologie*, 1839, i, 37-8, and *Krit. d. r. Vernunft*, ed. Reclam, pp. 113 ff. Typical of the common failure to notice the vital assumption of concomitance is the view of Hamilton, Lecture XXI.

CHAPTER XII

§ 1, p. 199. For Tiedemann and Titchener, see respectively: *Handbuch der Psychologie*, 1804, and *A Textbook of Psychology*, 1910, p. 52. For the scheme adopted in the present volume, see the writer's *Nature of Intelligence*, 1923.

p. 199. Attention must here be called to a troublesome equivocation in the word "quality". The Renaissance philosophers and psychologists, notably Locke, used the term in a much broader sense than we (following general usage) have done here. By them it was applied, not only to the cases where we have used it (e.g. to the appearance of yellow or to musical pitch), but also to the attributes of space and time. These latter attributes they distinguished as "primary" qualities, the other cases being called "secondary" qualities.

§ 2, p. 200. Wundt's circle is given in his *Grundz. d. phys. Psychologie*,

6th ed., II, p. 149. For pyramid of Titchener, see his *Text-book of Psychology*, p. 63.

§ 3, p. 202. Stratton, *Experimental Psychology and Culture*, 1908, pp. 146-9; Weber, *Annotations anat. et physiol.*, 1834, p. 47; Marillier and Philippe, *Journal de physiologie*, 1903, v; v. Frey, *Zeit. f. Psychol.*, 1902, xxix, pp. 161-83. For the acuity of vision, see Fröbes, *Lehrb. d. ex. Psychol.* i, 1922, p. 261.

§ 4, p. 204. Clay, *The Alternative*, p. 167; James, *Principles of Psychology*, i, 609. With both Clay and James the fundamental mistake seems to have lain in confusing the mentally presented times with the times of mental presentation. Obviously, the latter will in general outlast the former. For the real minimum interval, see Fröbes, *ibidem*, p. 384.

§ 5, p. 206. For these touch-spots, see Wundt, *ibidem*, ii, p. 15.

§ 6, p. 208. The experiments quoted on the subjectivity of sensation are as follows: Spearman, *Nature of Intelligence*, p. 224; R. B. Cattell, *The Subjective Character of Cognition*, 1930, pp. 146, 157; Bichowsky, *Amer. J. Psych.* xxxi, 1925, p. 588; Dickinson, *Amer. J. Psych.* xxxviii, pp. 266-79, 1927; Martin, *Amer. J. Psych.* pp. 451-80, 1922; Bose, "Is Perception an illusion?" *Indian J. Psych.* i, July 1926. Lewes is quoted from his *Problems of Life and Mind*, 1874, p. 101.

CHAPTER XIII

§ 2, p. 215. For Plato, see *Theaetetus*, 421-2. Aristotle is quoted from his *De Anima*, Bk. III, ch. ii, § 11.

p. 217. For Fröbes, see his *Lehrb. d. exper. Psychol.*, 1922, p. 456.

§ 3, p. 219. "Relatives": see Aristotle's *Categories*, ch. vii *et seq.* For Locke, see his *Human Underst.* Bk. II, ch. xxv.

p. 220. T. Brown, *Lectures on the Philosophy of the Human Mind*, 1820, p. 288; Fröbes, *Die exper. Psychol.*, 1923, p. 460.

pp. 221-2. Spencer writes as follows: "The proximate components of Mind are of two broadly-contrasted kinds—Feelings and Relations between feelings". . . . "Under an ultimate analysis what we call a relation proves to be the momentary feeling accompanying the transition from one conspicuous feeling to an adjacent conspicuous feeling." He continues: "Feelings and the relations between feelings correspond to nerve-corpuscles and the fibres which connect nerve-corpuscles. . . . The psychical relation between two feelings answers to the physical relation between two disturbed portions of grey matter, which are put in such direct or indirect communication that some discharge takes place between them" (*Principles of Psychol.*, 1855, vol. ii, pp. 163, 177, 190, 251).

Bain states definitely enough: "Consciousness of Agreement or Similarity constitutes a fundamental Law of Intellect". Nevertheless he formally defines this law as the tendency of present actions, sensations, thoughts, or emotions: "to

revive their like among *previously* occurring states". In best accord with this definition, he exemplifies the "consciousness of agreement" by the very case which so long before had been used by Plato to illustrate memory; the case where a portrait calls to mind the original person. Moreover, he altogether overlooks the primary and essential case of "consciousness of agreement", namely, between two or more actions, sensations, and so forth, which are *both* present. He leaves, for instance, no place for the perception of likeness between one person and another (*Senses and Intellect*, ch. ii).

For Meinong, see *Zeit. f. Psychol.*, 1891, p. 754.

§ 4, p. 223. Locke is quoted from *Hum. Underst.* Bk. II, ch. xiii. For Sully, see *The Human Mind*, 1892, p. 240. For Bühler, see his *Gestaltwahrnehmung*, 1913.

p. 225. Meinong, *Zeit. f. Psychol.*, 1894, vi; Cornelius, *ibidem*, 1900, p. 117.

§ 5, p. 226. "Continuity" has been defined as "relative sameness through a series of changes" (Baldwin's *Dictionary*). See the account given of Zeno in the *Parmenides* of Plato.

p. 227. "Is a continuum", the Schoolmen inquired, "composed of parts actually or only potentially?" "Is it, in so far as it is composed of parts, nevertheless one in itself?" "How many are its parts?" "Are the equal determined and non-overlapping parts infinite in number?" "Are the proportional non-overlapping parts infinite?" And so on, and so on.

§ 7, p. 233. *Perception of Relations*: Here we may note that the relations between the dots can be truly and certainly noticed even at a single glance. There seems to be no need of any act of "comparison" which proceeds from the one dot to the other.

In order to characterize the perception of relation by an act of comparison, the perceiver must analyse out separately the relation as such and the things related. The second way of perception, on the other hand, does *not* involve any such analysis; the relation and the things related remain throughout in most intimate "fusion" (see Külpe, *Outlines of Psychology*, p. 21). Thus Stout writes that: "The consciousness of relation *need not involve a distinction between the relation as such and the things related*. . . . We may be aware of *a* as distant from *b* without distinguishing the distance relation as such from its particular presentation in this special case." Moreover, both cases of perceiving relations must always be distinguished from the further case where the relations, although actually existing, are not perceived at all.

CHAPTER XIV

§ 1, p. 237. Diares and Cleon are mentioned respectively in vol. ii, ch. vi, para. 3, and vol. iii, ch. vi, para. 2, of Aristotle's *De Anima*.

§ 1, p. 238. For the Stoic view, see Diog. Laert. Bk. VII, para. 46.

§ 2, p. 239. " Complication " : Herbart, *Lehrb. z. Psychol.*, 1816, Pt. II, ch. iii.

pp. 241-2. For the experiments on reproduction, see Albien, *Zeit. f. exper. Psychol.* vol. v, 1907, and Goodenough, *Measurement of Intelligence by Drawing*, 1926. (Copyright of World Book Co., Yonkers-on-Hudson, New York.)

p. 243. Maher, *Psychology*, 1911, p. 127.

§ 3, p. 245. Fig. D is copied by permission from the spatial relations test of Brigham in his *Study of Errors*, 1932, p. 279. Figs. E and F are taken from Sanford's *Experimental Psychology*, 1903, p. 205.

p. 246. As akin to the adjusted supplements must be reckoned the much discussed " Phi-phenomenon " of Wertheimer.

§ 4, p. 246. Lewes, *Problems of Life and Mind*, 1874, vol. i ; Locke, *Hum. Unders.* Bk. I, ch. iv, § 18. The characters which Lewes called " supersensible " are explained by the present writer in *The Nature of Intelligence*, 1923, ch. vii, p. 107. The philosophical bearings of this explanation are set forth especially by Aveling in his *Psychological Approach to Reality*.

CHAPTER XV

§ 1, p. 250. " *Object* " *and* " *Subject* " *in original and acquired meanings.* The Schoolmen had devised the very suitable term *objectum* to mean that which is " put before " (*ob* and *jacio*) the cognitive faculty. It was apposed to *subjectum*, which meant the thing-in-itself which " underlies " such *objecta*. But the subsequent psychologists and philosophers of the Renaissance—more enterprising than their predecessors, but not always wiser—confounded the one signification with the other. Campanella (*Univ. Philos.*, 1638, II, ii, 1 ; II, v, 2) and Hobbes (*De Corpore*, 1655, xxv, 2, 10) appear to have been the erring bell-wethers ; and almost every later author has more or less pliantly followed in their tracks. As regards the modern " subject ", the equivocations introduced do not come under discussion here. But as regards the modern " object ", we have to realize that this currently contains a mixture of the old *objectum* together with the old *subjectum*, that is to say, of the thing-put-before-the-mind and the thing-in-itself. The proportion and manner in which these two are blended seem to depend only on the writer's general idiosyncrasy and his momentary argumentative difficulties. And even those who know of and denounce the equivocation appear to be little more able than others to prevent themselves from committing it in practice. Maltreatment of language is apt to give wounds that will not heal.

p. 251. Plato, *Theaetetus* ; Cary, vol. i, p. 386. Fichte's chief work is his *Grundlage d. gesamten Wissenschaftslehre*, 1794 and 1802 ;

Aquinas, *Summ. Theol.* Pt. I, Q. 77, art. iii; Brentano, *Psychologie vom empirischen Standpunkte*, 1874, Bk. II, ch. i, § 3.

§ 1, p. 253. See, for instance, Stout's article on the "Classification of the Mental Functions" in Baldwin's *Diction. Philos. and Psychol.* See also articles by Nunn entitled "Are Secondary Qualities independent of Perception?" and by Moore on "The Subject-matter of Psychology" in *Proc. Aristotelian Soc.* W.S., vol. x, 1909–10, and by Dawes Hicks on "The Relations of Subject and Object", *ibidem*, 1907–8. For Wolf and Alexander, see their respective articles on "Natural Realism and Present Tendencies in Philosophy" and "Foundations and Sketch-plan of a Conational Psychology" in *Brit. Jour. Psychol.* vol. iv, 1911. Ward, *Encyclop. Britann.*, 10th ed., art. on "Psychology".

Brentano writes as follows: "Every psychic phenomenon is characterized by what the Schoolmen of the Middle Ages named the intentional (also mental) in-existence of an object (*Gegenstand*). We should call it—not quite without equivocation—the relation to a content, the direction towards an object (*Objekt*)—without thereby implying any reality—or the immanent objectivity" (p. 115). On behalf of the word "in-existence", Brentano quotes Aquinas. As a matter of fact, however, this author seems never to have employed it, although he makes free use of *existere* and, in another meaning, of *inesse*. He does, however, write much about "intentional entities" in a sense similar to that of Brentano. Boethius used the word "inexistence" but in a different signification, that of Aristotle (see Boethius, *Aristot. Analyt. prior.* 1, 11). Later on, it did come into the usage asserted by Brentano. Collier, for instance, wrote: "That manner of *in-existence*, after which all material exists, is affirmed by me to *exist in the mind*" (*Clavis Universalis*, 1713). The word gives rise to an unfortunate equivocation. Besides our present "existence-in", it also suggests the almost contrary one of "non-existence". Long even before this, the description would appear to have already been delineated by Plato; and no less so, by Aristotle. And the description given by Descartes nearly three centuries ago was as explicit and forcible as that of Brentano today. Again and again, we find the event or process of knowing distinguished from that which is known.

§ 2, p. 255. Porter, *The Human Intellect*, 1872. Empedocles, *Frag. Coll. Stenzii*. A general account of the primitive doctrines of images is given in Theophrastus' *De Sensu*. For a translation we have recently had to thank Stratton. Lucretius is quoted from his *De Rerum Natura*, Bk. V, ver. 35-6 and 726 ff. The French "idée" and the English "idea" thus approach to translating the Greek "εἶδος" rather than the "ἰδέα".

§ 2, p. 256. Spinoza: "Mens humana non tantum corporis affectiones, sed etiam harum affectionum ideas percipit" (*Ethica*, Pt. II, prop. 23). For Occam, Major, Biel, and Durand, see Biel, *In secundum lib. sentent.* Dist. III, QQ. ii and iii; Piccolomini, *De humana mente*, Bk. III, ch. vii; Arnauld, *Traité des vraies et des fausses idées*, 1683; Reid, *Intellectual Powers*, 1785, ch. ii; Stewart, *Philos. of the Hum. Mind*, 1792, Pt. I, ch. i; Th. Brown, *Philos. of the Hum. Mind*, 1920, lects. 22 and 26; Hamilton, *Metaphysics*, 1859–61, lects. 21 and 26; also his notes to the works of Reid, 1896 [B, C, D, and D*].

§ 3, p. 257. Malebranche, *De la recherche de la vérité*, Bk. III, Pt. II, ch. vii.

CHAPTER XVI

§ 1, p. 268. Aristotle, *De Anima*, Bk. III, ch. iii, also Bk. II, ch. iii.

p. 269. Plato, *Theaetetus*.

§ 2, p. 271. Suarez, *De Anima*, Bk. IV, ch. ii, § 18; Campanella, *Universalis Philosophiae*, 1638, Pt. I, Bk. I, ch. v, art. i; Rosmini, *Nuovo Saggio*, vol. ii.

p. 272. Locke, *Hum. Underst.* Bk. IV, ch. v, sec. 9; Berkeley, *Prin. Hum. Knowledge*, 1710, introd., sec. 10; T. V. Moore, *Process of Abstraction*, 1910; Aveling, *Consciousness of the Universal*, 1912; English, "Process of Abstraction", *Am. J. Psych.*, 1922; Stevanović, *Br. J. Psych. Mon. Suppl.*, 1927; Sander, *Psych. Congress*, Germany, 1927. See also Spearman's *Nature of Intelligence*, 1923, pp. 181-2.

§ 3, p. 273. Plato, *Soph.* 263 Ef.; *Theaet.* 187 A, 190 A. For Stoics on τὸ λεκτόν, see Sieback, *Ges. d. Psychol.* ii. p. 294; Diogenes, *Zeno*, xxxviii; Aristotle, *De Anima*, Bk. III, ch. iii, § 6. The definition of "image" is taken from Baldwin's Dictionary. Spinoza, *Ethics*, Pt. II, prop. xl. Among other adherents to Spinoza's doctrine may be cited the names of Herbart, Galton, Huxley, Ueberweg, Ribot, Sully, James, Erdmann, and Külpe (in earlier work).

§ 5, p. 274. Bühler, *Tatsachen u. Probleme zu einer Psychologie der Denkvorgänge*, 1907.

p. 275. See here the recent interesting *Place of Imagery in Mental Process*, by Pear, 1937.

p. 277. The quotation about the "twitch" and so forth is from Helen Clark in the *Am. J. Psychol.* xxii, 1911. Moore, *Psych. Rev.* xxii, 1915.

§ 6, p. 279. For Berkeley and Hume, see respectively *Princ. of Hum. Knowledge*, xxiii, and *Treatise on Human Nature*, Bk. I, Pt. III, § 19. Aristotle, *De Anima*, Bk. III, ch. vi; Plato, *Soph.* 259 E.

§ 7, p. 281. Locke, *Hum. Underst.* Bk. IV, ch. xiv.

§ 8, p. 284. Ballard, *Thought and Language*, 1934.

§ 9, p. 286. For the complexity of deductive thinking, see Menon, Thesis in Library of Univ., London, 1929.

§ 11, p. 287. Reid, Essay VI, ch. iv.

§ 12, pp. 288-92. Aristotle, *De Memoria.* For Edgell and Bartlett, see respectively *Theories of Memory*, 1924, p. 136, and *Remembering*, 1932, p. 214. For Edwards' work, see *Psychological Basis of Memory*, Thesis in Library of Univ. London, 1928. Hobbes, *Concerning Body*, ch. xxv; Müller, *Gedächtnistätigkeit*, 1911, vol. iii, sec. 12. For "assimilation", see Henderson, *Psych. Der. Mon. Suppl.* xxiii, 1903. Plotinus, *Enn.* IV; Leibniz, *Nouveaux Essais*, Bk. II, ch. xxvi; Royer-Collard, Fragments in *Œuvres de Reid*, trans. Jouffroy. For Reid, see *Essays on the Intellectual Powers*, III, ch. 3.

CHAPTER XVII

§ 1, p. 298. For διάνοια and λογισμός, see Aristotle, *De Anima*, Bk. II, ch. iii. For λογιστικόν, θυμικόν and ἐπιθυμητικόν, see Bk. III, ch. ix.

§ 2, p. 299. The Stoic view is set forth by Siebeck in his *Geschichte d. Psychol.* ii, ch. v, 1880. Nunn on the Horme: see his *Education*, 1930, p. 23. McDougall on same subject: *Psychologies of 1930*, 1930, p. 3.

§ 3, p. 301. Aquinas, *Summ. Theol.* Pt. II, Q. vi, art. 1, and Q. xvi, art. 4.

§ 4, p. 303. Descartes, *Passions*, i, 17; Spinoza, *Ethics*, II, xlix, coroll.; Bastian, *Brain*, xv, 1892, p. 34.

§ 6, p. 304. Hartley, *Observations on Man*, 1749, pp. 59, 64; Hume, *Treatise on Human Nature*, Bk. II, Pt. III, § 1.

p. 305. J. Mill, *Analysis of the Phenomena of the Human Mind*, 1829, pp. 254, 280, 399.

§ 7, pp. 306-7. James, *Princ. of Psychol.*, 1890, ii, p. 499; Ferrier, *Functions of the Brain* (Works, 1866).

§ 8, pp. 308-9. Hooker, *Eccles. Pol.* Bk. 1. For Hobbes and Hume, see respectively *Leviathan*, Pt. I, *Of Man*, 1651, and *Treatise*, Bk. II, Pt. III, sec. iii.

§ 9, pp. 310-11. For Hunter and McDougall, see *Psychologies of 1930*, pp. 282 and 4, respectively.

§ 10, p. 312. Aveling is quoted from *Brit. J. Psychol.*, 1926, xvi, "The Psychology of Conation and Volition".

§ 11, p. 313. Aristotle, *Organon*, Categories, ch. viii; Aquinas, *Summ. Theol.* Pt. II, Q. xxii, art. 2; Lotze, *Mikrokosmos*, 1856, Bk. II, ch. v; Clouston, *Mental Diseases*, 1898, p. 340.

p. 314. Locke, *Hum. Unders.* Bk. II, ch. xxi; Biran, *Science et Psychologie*, 1887, ch. i.

p. 315. For the concept of "Force", see in particular *Psychological Approach to Reality*, by Aveling, 1929; *Frontiers of Psychology*, by McDougall, 1934; *Creative Mind*, by Spearman, 1930.

§ 12, p. 315. For "activity", see Brett, *History of Psychology*, 1921, Bk. III, pp. 20 and 21; J. S. Moore, *Foundations of Psychology*, 1921, p. 24; Janet and Seailles, *Histoire de la philosophie*, 1899, p. 68; Flugel, *Hundred Years of Psychology*, 1934, p. 33.

CHAPTER XVIII

§ 1, p. 318. Formerly the opposite to pleasure was taken to be "pain". But then it was discovered that under this name the affective state was being confused with certain sensations (especially cutaneous). Another usual name for the opposite of pleasure has been *dis*pleasure. But this has the disadvantage of bringing in the irrelevant idea of anger.

§ 2, p. 320. Locke and Hume are quoted from *Hum. Underst.* Bk. II, ch. vii, and *Treatise on Hum. Knowl.* Pt. IV, § 2, respectively. Hartmann, *Kategorienlehre*, 1896, p. 66.

§ 3, pp. 321-2. Maher, *Psychology*, 1911, p. 226; Herbart, *Lehrb. z. Psychol.* Pt. II, § 147; Krueger, *Feelings and Emotions*, Wittenberg Symposium, 1928, p. 67; see also his *Das Wesen der Gefühle*, 1937. For Mill, see his *Analysis of Hum. Mind*, ii, p. 143; and also Fröbes, *Lehrb. d. exp. Psychol.*, 1923, i, p. 179. Head, *Brain*, 1911–12; Wohlgemuth, "Pleasure—Unpleasure", *Brit. J. Psychol. Mon. Suppl.*, 1919.

§ 4, p. 325. For the linkage of feelings to object, see Fröbes on the "intentionality" of the feelings, *op. cit.* ii, p. 263 *et seq.*; Wohlgemuth, *op. cit.* p. 235.

§ 5, p. 326. For Plato, see *Philebus*; for Aristotle, see his *Ethics*.

p. 327. Descartes, Sixth letter in First Part of his *Epistles*; Allen, *Physiological Aesthetics*, 1877; Marshall, *Pain, Pleasure and Aesthetics*, 1894; Lehmann, *Hauptgesetze des menschlichen Gefühlslebens*, 1892, 1914.

§ 6, p. 328. Spinoza, *Ethics*, Pt. III, prop. lix; Wundt, *Grundz. d. phys. Psychol.*, 1908.

§ 7, p. 330. The definition of "emotion" is taken from Baldwin's Dictionary. James, *Princ. of Psychol.*, 1890, ii, p. 448.

p. 331. For view of Schoolmen, see Aquinas, *Summ. Theol.* Pt. I, Q. lxxxi, and Pt. II, Q. xxiii. McDougall's list is as follows: Fear, anger, disgust, tender emotion, distress, lust, curiosity, feeling of subjection, elation, feeling of loneliness, craving, feeling of ownership, feeling of creativeness, and amusement (*Outline of Psychology*, 1923, p. 324; see also pp. 316-17).

p. 332. Lotze, *Medizinische Psychol.*, 1852.

p. 333. Lindworksky, *Exper. Psychol.*, 1931, p. 206.

§ 8, p. 334. Lehmann, *Körperliche Aeusserungen psychischer Zustände*, 1904 and 1907.

CHAPTER XIX

§ 1, p. 336. For Aristotle's discussion of the "Motive Faculty", see his *De Anima*, Bk. III, chs. ix and x.

§ 2, p. 337. Descartes, *Les Passions de l'âme*, 1650, Pt. I, art. 16.

p. 338. For McDougall's view of reflexes, see his *Physiol. Psychology*, 1905, pp. 46 ff.

§ 3, p. 341. Aquinas, *Summ. Theol.* Pt. I, Q. lxxxi, art. 2.

§ 4, p. 342. Hamilton, *Lectures*, 1859, lect. 42.

p. 343. McDougall, *Introd. Social Psychol.*, 1908, ch. ii, and *Outline of Psychol.*, 1923, ch. vi.

p. 344. Aristotle, *Nic. Ethics*, Bk. X, ch. iv.

CHAPTER XX

§ 1, p. 348. Shand, *Foundations of Character*, 1914, p. 23; Aristotle, *Nic. Ethics*, Bk. I, ch. ii.

§ 2, p. 349. The word instinct has a troublesome equivocation. Originally, it was a translation of horme (see p. 299) and was applied to any action not attributable to "reason". But it came to have also the more limited meaning which we have here indicated by the term specific.

p. 350. Wundt, *Grundz. d. phys. Psychol.*, 1911, iii, p. 734. For McDougall's contrast between purpose and reflexes, see his *Outline of Psychology*, 1922, ch. ii.

§ 4, p. 352. Ribot, *La Logique des sentiments*, 1905, p. 69; Dugas, *La Timidité*, 1898.

§ 5, p. 354. Shand, *op. cit.* p. 35; McDougall, *Introd. Social Psychol.* p. 122; Aquinas, *Summ. Theol.* Pt. II, Q. xxiii.

§ 6, p. 356. Pierre Janet, *Névroses et idées fixes*, 1898, i, p. 381; Morton Prince, *Clinical and Experimental Studies in Personality*, 1929, Preface; Freud, *Collected Papers*, 1925, pp. 202-4, 214-16.

p. 360. For Jung's secession from Freud, see the former's articles in *Jahrb. f. Psychoanalytische u. psychopathologische Forschungen*, 1902, ii and iii. For Adler, see his *Ueber den nervösen Charakter*, 1912. William Brown, *Mind and Personality*, 1926.

p. 361. Hart, *Psycho-pathology*, 1927.

§ 7, p. 361. For Dilthey's attack, see his *Einleit. in d. Geisteswiss.*, 1883. J. S. Mill, *System of Logic*, 1843.

p. 362. For Spranger, see his *Lebensformen*, 1925.

CHAPTER XXI

1, p. 368. Aristotle is quoted from *De Anima*, Bk. III, ch. iii. With this may be compared his νοήσις and νοήσεως, *Nich. Ethics*, ix. 9. Plotinus, Works, *Ennead*, I, Bk. IV, 10.

p. 370. Locke is quoted from his *Hum. Underst.* Bk. II, ch. xxvii, § 9; Hamilton from the *Works of Reid*, note H, p. 929. Reid's limitations of consciousness:

The first is—that it is a knowledge.

The second—that it is a knowledge known by me.

The third—that it is an immediate and not a mediate knowledge.

The fourth—that it is an actual not a potential knowledge.

The fifth—that it is an apprehension.

The sixth—that it is a discrimination.
The seventh—that it is a judgment.
The eighth—that whatever is thought is thought under the attribute of existence.
The ninth—that while only realized in the recognition of existence, it is only realized in the recognition of the existent as conditioned.
The tenth limitation is that of Time.

§ 2, p. 371. Montaigne, *Essais*, ii, 14; Leibniz, *Nouveaux Essais*, ii, 11.
p. 373. Kant, *Anthropologie*, 1800, Pt. I, 16; Herbart, *Lehrb. z. Psychol.* Pt. II, § 2, ch. i.
p. 375. Hamilton, *Lectures*, 1865, lect. xviii. Hartmann is quoted from his *Philosophy of the Unconscious*, trans. by Coupland, 1893. (A) I, (B) XI, (C) III, (C) VII, (C) XII, (C) XV.
§ 3, p. 378. For the relations between the earliest clinical studies of the Unconscious, see Morton Prince, *Clinical and Experimental Studies in Personality*, 1929, Appendix. For Prince's account of Miss Beauchamp, see *ibidem*, ch. vii.
p. 379. F. Myers, *Human Personality*, 1903, ch. ii.
§ 4, p. 380. Hamilton, *op. cit.*; Lewes, *Study of Psychology*, 1879, ch. i, especially pp. 14 ff.; Hartmann, *Grundriss der Psychologie*, 1908, p. 141.
§ 5, p. 382. Hart, *Psychopathology*, 1927, pp. 61-2.

CHAPTER XXII

§ 1, p. 387. Bradley, *Appearance and Reality*, 1893, p. 101.
§ 3, p. 391. For Plato, see his *Phaedo*, i. ἡγεμονικόν: see Siebeck's *Geschichte d. Psychol.*, period II, § 2, ch. iii; Augustine, *De Trinitate*, x, 10, 14; Descartes, *Meditations*, iii, p. 73.
p. 392. Porter, *The Hum. Intellect*, 1872, p. 95.
§ 4, p. 393. Locke, *Hum. Underst.* Bk. II, ch. xxiii, § 1; Bk. IV, ch. iii; Spinoza, *Ethics*, Pt. I, Definitions, and Prop. XI; Read, *Metaphysics of Nature*, 1905, p. 205.
§ 5, p. 393. For Locke and Hume, see respectively *Hum. Underst.* Bk. II, ch. xxvii, and *Treatise*, Bk. I, Pt. IV, § 6.
p. 394. For Mill and James, see respectively their *Exam. of Hamilton's Philosophy*, 1878, ch. xii, p. 248, and *Princ. of Psychol.*, 1890, pp. 339-40.
§ 6, p. 395. Herbart is quoted from his *Lehrb. z. Psychol.*, 1816, Pt. II, p. 90; Mach from his *Analyse d. Empfindungen*, 1903, p. 19; Höffding from *Outlines of Psychol.*, 1891 (English), V, B, 5; Bradley from his *Appearance and Reality*, 1893, p. 95; Husserl from *Logische Unters.*, 1900, ii, pp. 326 ff.; Titchener from *Textb. in Psychol.*, 1911; Th. Lipps from *Grundtatsachen d. Seelenlebens*, 1883, pp. 408, 437, and *Psychologie*, 1901, p. 2; James from his *Principles*, pp. 291-301.
§ 7, p. 396. Berkeley, *Principles*, xxvii.
§ 8, p. 397. Kant, *Kritik d. reinen Vernunft*, Reclam ed., p. 303. For

Jodl, see his *Lehrb. z. Psychol.*, 1908, p. 120. Further reference may be made to the works of Herbart, Maine de Biran, Cousin, Lotze, Green, Ward, Natorp, Lossky, Lipps, and Sudd.

§ 8, p. 398. Kant, *Kritik d. reinen Vernunft*, p. 303 and Suppl. III. For Ward on Kant, see *Psychological Principles*, 1918, p. 35. James, *Principles*, i, p. 291.

§ 9, p. 401. For Prince, see his *Clinical and Exper. Stud. in Personality*, pp. 411-14; Ach, *Ueber d. Willenakt u. das Temperament*, 1910; Dürr, *Die Lehre v. d. Aufmerksamkeit*, 1907; Michotte and Prüm, *Étude exper. sur le choix voluntaire*, 1910; Katzaroff, *Archives de psychol.*, 1911; Boyd Barrett, *Motive Force and Motivation-tracks*, 1911. For views of Aveling, see especially his "Psychology of Conation and Volition", *Brit. J. Psychol.*, 1926.

CHAPTER XXIII

§ 1, p. 404. Busse, *Geist u. Körper*, 1913, p. 236; Stout, *Manual of Psychol.*, 1913, Introd. ch. i, p. 4.

§ 2. pp. 405-406. Baldwin, *Handbook of Psychol.*, 1890, ch. iv, p. 65; T. H. Green, *Prolegomena to Ethics*, 1883, Bk. I, § 28, p. 35; Hartmann, *Philosophie d. Unbewussten*, 1871, 3rd ed., X, iii, p. 427; Clifford, "On the Nature of Things-in-Themselves", *Mind*, 1878; Sokappe, *Grundriss der Erkenntnistheorie und Logik*, 1894, 107; Ardigo, *L'Unita della conscienza*, 1898, Pt. III, ch. viii, p. 503; Ward, *Encyclopaedia Britannica*, ed. 9, p. 79, "Psychology"; Ebbinghaus, *Grundzüge d. Psychol.*, 1905, § 43.

p. 406. Sully, *The Human Mind*, 1892, ch. xii, § 25, p. 479; Lotze, *Microcosms*, 1876, 3rd ed., Bk. II, ch. i, pp. 170 ff.; Höffding, *Psychologie*, 1893, v, B, 5, p. 186; Spencer, *Principles of Psychol.* Pt. VI, ch. xxvii, p. 297; Locke, *Hum. Unders.* Bk. II, ch. xvi, § 1.

§ 3, p. 408. Cajetanus, *Scholastici in* 1 *distinct.* 24; Caproleus, *In libros Sententiarum*, 1599; Durandus, *In Sententias Theologicas*, 1556; Gabriel, *Super Quatuor libros Sentiarum*, 1514; Henry of Ghent, *Quodlibet. Theologica*, 1283, Q. i; Jandunus: *Quaestiones in duodecim libros Metaphysicae ad Aristotelis*, 1540; Soncin, *Quaestiones in Aristotelis XI Metaphysicos libros*, 1576; P. Fonseca, *Commentariorum in libros Metaphysicorum Aristotelis*, 1539; Aegidius, *Metaph.* Q. vi; Aquinas, *De Unitate Intellectus*. Cf. also "*unum non addit supra hens rem aliquam sed tantum negationem divisionis*" (*Summ. Theol.* Q. xi).

9, p. 417. Mach, *Analyse d. Emfindungen*, 1902, p. 22; Read, *The Metaphysics of Nature*, 2nd ed., 1908, ch. x, § 6; Suarez, *Metaph. Disputa.*, 1605, p. 73. Wolf writes similarly: "*Inseparabilitas eorum, per quae ens determinatur unitas entis appellatur*" (*Ontologia*, 1729, 328).

CHAPTER XXIV

§ 1, p. 419. Koehler, *Pedagog. Seminary*, 1925, p. 705; Wertheimer: *Vortrag über Gestalttheorie*, 1924.

p. 420. Among the numerous writings of Krueger may be specially mentioned his "*Ueber psychische Ganzheit*" in *Neue psychologische Studien*, 1926.

§ 2, p. 421. The equivocal character of the word "Gestalt" has been especially attacked by Rignano in *Scientia*, 1927, 1928.

p. 422. Ehrenfels, *Vierteljahress. f. wiss. Phil.* xiv, 1890, p. 249.

§ 4, p. 428. Werthheimer, *Vortrag über Gestalttheorie*, 1924: "Es gibt Zusammenhänge, bei denen nicht, was im Ganzen geschieht, sich daraus herleitet, wie die einzelnen Stücke sind und sich zusammensetzen, sondern umgekehrt, wo—im prägnanten Fall—sich *das, was an einem Teil dieses Ganzen geschieht, bestimmt von inneren Strukturgesetzen dieses seines Ganzen.* Ich habe Ihnen hier einen Formel gesagt und könnte nun eigentlich enden. Denn Gestalttheorie ist dieses, nichts mehr und nichts weniger" (author's own italics).

p. 429. For the explicit adoption of "wholeness" (rather than "Gestalt"), see Volkelt, *Neue psychol. Studien*, vol. xii, p. 15. *Holism and Evolution* is the title of a very notable book by Smuts.

§ 5, p. 430. The old definition of a whole ran as follows: "*Totum est quod constat plurium rerum unione*".

§ 6, p. 431. Krueger, *Neue psychol. Studien*, 1926.

p. 432. Petermann, *The Gestalt Theory*, 1932, p. 154.

§ 10, p. 443. The passage of Koffka is quoted from his article in *The Psychologies of 1925*, 1927, p. 141.

CHAPTER XXV

§ 3, p. 449. We have here the basis of the great philosophical proposition of Fichte: "A posits not-A". Indeed, we might go a step further. If we include introspection, we arrive at a still stranger proposition: "A posits A" (*Grundlage d. ges. Wissenschaftslehre*, 1794).

CHAPTER XXVI

§ 1, p. 3. The quotation from James comes from the last page of his *Briefer Course*. But the pessimistic note was already struck in his earlier and larger *Principles*.

§ 4, p. 4. Joseph, *Mind*, xix, N.S., 1910.

§ 6, p. 5. Hamilton, *Lectures*, 1865, vol. ii, p. 231.

§ 7, p. 6. For Dilthey and Heymans, see respectively *Sitz. d. preuss. Akad. d. Wiss.*, 1894, and *Zt. f. angew. Psych.*, 1906–9.

§ 8, p. 6. For the views of Yerkes and Jarred Moore, see respectively their *Introduction to Psychology*, 1911, and *Foundations of Psychology*, 1921.

CHAPTER XXVII

§ 1, p. 8. Hartley, *Observations of Man*, 1749, p. 1.
§ 2, p. 11. Sigwart, *Logik*, 1889, vol. ii, pp. 548-55.
§ 3, p. 12. J. S. Mill, *System of Logic*, 1843, Bk. III, chs. v and vi.
p. 14. *Conjoint Causation.*—This is perhaps most happily expressed in mathematical fashion. When some change in x is caused by any changes in a, b, c, etc., we say that x is a "function" of a, b, c, etc. We symbolize this, accordingly, as:

$$x = f(a, b, c, \ldots)$$

Here the changes in a, b, c, etc., *may* work additively, but instead they may have any other quantitative relations. Most important, however, is the fact that in the great majority of cases they work additively as a first *approximation*.

§ 6, p. 15. Often at first sight a reduction of laws to others may, instead of diminishing their number, even augment it. Thus in physics the law of the motion of a planet was resolved into: a, the law of the acquired force which tends to produce a uniform motion in the tangent; and b, the law of the centripetal force which tends to produce an accelerating motion towards the sun (Mill, 305). Similarly, the single law that the duration of the swing of a pendulum remains constant is reducible to all three laws of motion.

But a little thought shows that even in such cases the law of the compound motion is less general than those of the two more elementary motions. For the former only holds when the two latter are combined, whereas these continue to hold even when they are separate. Here again we meet the scientific effectiveness of analysis and the ineffectiveness of limiting consideration to "wholes".

As an instance of intermediate links, an act of touching may originally seem to produce a tactual sensation, whereas subsequently the stimulation of the sensory nerve is found to intervene between the two. Here, again, the result is to increase the generality of the laws (and therefore eventually to decrease their number). The stimulation of the nerve can take place even where no sensation ensues, as may happen under strong distraction or in the case of brain injury.

Two remarks may be appended. One is that although the ultimate laws possess the highest scientific significance, yet curiously enough the practical mission of deducing consequences may be more easily served by the derivative laws. Thus, in the example of the pendulum (simple), we can at once predict and verify that, on the length being diminished to a quarter, the time of vibration will be doubled. But in

the case of the more general law that bodies persevere in uniform motion, to verify this in actual experience is rarely if ever possible.

The other comment to add is that the items to which laws apply may be either observable or else only hypothetical. Of the former kind are the laws of motion. Of the latter, the law of conservation of energy. This energy is something that no one could possibly perceive, however much any complicating factors be smoothed away; it is at bottom nothing more than an invention, a provisional guess, for scientific convenience. Still even the laws governing such hypothetical entities are as genuinely prophetic as the others (although they may for this purpose involve much mediating calculation).

§ 7, p. 16. Hume, *Treatise*, Bk. I, § 14, p. 161. The definition of "empirical" laws is taken from Mill. Malebranche, *Traité de la morale*, 1684. Maine de Biran, *Science et psychologie*, 1887, p. 127.

§ 8, p. 18. For the nature of the "Ideal" Law, see particularly Lewes, *Problems of Life and Mind*, 1874, Problem I, chs. v and vi.

CHAPTER XXVIII

§ 2, p. 22. Plato is quoted from his *Phaedo*, 73-6, trans. Jowett.

§ 3, p. 23. Hamilton, *Works of Reid*, 1863, note D, p. 889. Aristotle, *De Memoria*, trans. Rose, pp. 109-11.

§ 4, p. 25. Augustine, *Confessions*, Bk. X, ch. xix.

p. 26. Hartley's supplementary statement is quoted from Prop. X.

p. 27. For Mill, see his *Analysis of the Human Mind*, 1829, vol. i, ch. iii, and vol. ii, ch. xi.

§ 5, p. 29. The following are among those who would reduce the case of similarity to a special instance of contiguity: Maass (*Versuch über die Einbildungskraft*, 1792), T. Brown, James Mill, Lewes, James (*Principles*, i, ch. xiv), Ward, Lehmann (*Phil. Stud.*, v), and Foucault (*Archives de psychol.*, 1911). Among those who, on the contrary, would make the case of resemblance prior to that of contiguity are: Spencer (*Principles*, i, 252 ff.), Dumont (*Rev. de métaph*, iii), and perhaps even v. Kries.

For Höffding, *Outlines of Psychol.*, 1891 (English), ch. v. For Hamilton, see his *Works of Reid*, note D. Among others who seem to have admitted *both* cases, resemblance and contiguity, to be fundamental, may be mentioned: John Mill, Bain, Condillac, Mervoyer, Taim, Ernesti, Beneke, Tetens, and Brochard.

§ 6, p. 30. For Bain, see his *Senses and Intellect*, 1868, Bk. II, ch. i, also his "Association of Ideas" in *Chambers's Encyclopaedia*, 1901.

§ 7, p. 32. On the forward and backward action of association, see Wohlgemuth in *Brit. J. Psychol.* v, 1913.

CHAPTER XXIX

§ 1, p. 39. Hamilton, *Lectures*, ii, pp. 205 ff.; Tetens, *Philos. Versuche*, 1777, p. 56 ff.

p. 40. Thomas, *Ability and Knowledge*, 1935, Pt. III, ch. ix.

§ 2, p. 42. For Descartes, see his *Œuvres*, vol. ix, p. 167, ed. Cousin (ref. given by Hamilton, ii, 219). For Malebranche and Locke, see respectively *Recherche de la vérité*, 1675, Bk. II, Pt. I, ch. v, and *Hum. Underst.* For van Biervliet, *La Mémoire*, 1902, ch. i.

The formula of Piéron: $\log x = Kt + b$, where t is the duration of the process and x is the amount of transformation effected. K and b are parameters. See his *L'Évolution de la mémoire*, 1910, p. 38. Courtis, *School and Society*, 1929. Moore, *Aspects of the New Scholastic Philosophy*, edited A. C. Hart, 1932. Gulliksen, *Journal of General Psychology*, 1934.

In the preceding equation, t is taken to be the number of repetitions, whilst K and b are constants determined experimentally.

p. 45. For Müller, see his *Lehre v. Gedächtnis* (with Pilzecker), 1902, ch. ii.

p. 46. " Recitation ": see A. I. Gates's " Recitations as a Factor in Memorizing ", 1917, *Archives of Psychology*. For the effect of the interposition of intervals, see Jost in *Zeit. f. Psychol.*, 1897, vol. xiv.

§ 4, p. 47. Thorndike, " Educational Psychology ", *The Original Nature of Man*, i, p. 1; and also *Psychology of Learning*, 1913, p. 6; Pavlov, *Conditioned Reflexes*, 1927.

§ 5, p. 50. The case of " conversion " is taken from McDougall's *Outline of Abnormal Psychology*, 1926, p. 277.

p. 51. Boyd Barrett, *Motive-force*, 1911, pp. 131, 159.

p. 52. Thorndike, *loc. cit.*

p. 53. Thouless, *B. J. Psych.*, 1931.

§ 7, p. 57. For a general account of the controversy about " transfer of training ", see W. H. Heck, *Mental Discipline and Educational Values*, 1909, i; see also James' *Principles*, vol. i, p. 667. The quotation on the use of Latin is taken from Thorndike's *Princ. of Teaching*, p. 250, 1906. Shendakur, *Teaching to solve problems in Arithmetic*, 1930. Thesis in Univ. London Library. For Laycock, see his *Adaptability to New Situations*, 1929. For reference to Judd, see *Psychol. Review*, ix, 1902.

CHAPTER XXX

§ 1, p. 59. Aristotle, *De Memoria*, 453; Malebranche, *Rech. de la vérité*, Bk. I; Hartley, *Observations on Man*, Prop. III.

§ 2, p. 60. For Marcus Herz, see *Essays on Vertigo*, 1791. Herbart's

formula: $z = \phi(1 - e^{-\beta t})$, where ϕ denotes the sensitivity of a person, t is the duration of the stimulus, whilst z is the quantity of the presentation produced.

§ 2, p. 61. McDougall, "Variation of the Intensity of Visual Sensations", *Brit. J. Psychol.* i, 1904. The research was subsequently continued by him in collaboration with Flugel, *ibid.* iii, 1909.

§ 3, p. 63. Lloyd Tuckey, *Treatment by Hypnotism*, 1900, p. 339.

§ 4, p. 64. Ballard, "Obliviscence and Reminiscence", *Brit. J. Psychol.* Mon. Suppl., 1913.

§ 5, p. 65. "Assimilation": For the reduction of the phenomena to special cases of retentivity, see "The Origin of Error", by present writer, *J. Gen. Psychol.*, 1928, i.

§ 6, p. 68. For a general account of "perseveration", see Wynn Jones, *Theory and Practice of Psychology*, 1934, ch. xviii. The literature quoted by him includes the work of G. E. Müller and A. Pilzecker, O. Gross, Bernstein, Stephenson, Hargreaves, Ach with Kühle and Passarge, Ziehen, Cushing, Seemann, Pinard, and R. B. Cattell. Thomas, *Ability and Knowledge*, 1935, p. 79 ff.

CHAPTER XXXI

§ 2, p. 72. Nunn, *Education, its Data and First Principles*, rev. edn., 1930, p. 35.

§ 3, p. 73. C. M. Cox, *Genetic Studies of Genesis*, ed. Terman, vol. ii.

§ 4, p. 74. T. V. Moore, *Psychol. Mon.*, 1919, xxvii, p. 110; Panicelli, "Influenza della cosidetta volunta di apprendere sui processi di apprendimento", *Rivista di psicol.*, 1914; Mulhall, E., "Experimental Studies in Recall and Cognition", *Am. J. Psychol.*, 1915; Wild, Thesis, Library of University of London, 1926.

§ 5, p. 78. Mercer, Thesis, Library of Univ. London, 1935.

§ 6, p. 79. Menon, Thesis, Library of Univ. London, 1929.

§ 7, p. 81. Bair, *Psychol. Rev.*, 1901, viii, p. 474 ff.

p. 82. Woodworth, *Studies in Philosophy and Psychology*, by Former Students of Garman, 1906. For Van der Veldt's and Bu's investigations, see their Theses in Univ. London, 1928, and Univ. Louvain, 1934, respectively. For Philp on "Frustration", see his Thesis, Univ. London.

CHAPTER XXXII

§ 1, p. 86. In Latin the proverb ran: *Pluribus intentus minor est ad singula sensus.*

§ 2, p. 86. Aristotle: *De Sensu*, p. 93. Nemesius: *Numerum autem eorum, quae cernuntur, si plus tribus est aut quattuor, qui uno aspectu non cernitur, motus etiam et figuras multorum angulorum numquam (visio) sola, sed cum memoria et cogitatione sentit* (*De Natura Hominis*, 1556, ch. vii, ed. Malthaei, p. 164).

§ 2, p. 88. The proposition debated was: *Possitne intellectus noster plura simul intelligere.* Hamilton, in his Lecture XIV, sums up the answers as follows: "Maintaining the negative, we find St. Thomas, Cajetanus, Ferrariensis, Capreolus, Hervæus, Alexander Alensis, Albertus Magnus, and Durandus; while the affirmative was asserted by Scotus, Occam, Gregorius, Ariminensis, Lichetus, Marsilius, Biel, and others." Bonnet, *Essai de psychologie*, 1775, ch. 38. Hamilton's experiment is given in the Lecture XIV, quoted above, p. 254; Jevons' in his *Nature*, 1871, p. 281. Cattell, *Phil. Stud.* iii, 1886, pp. 121 ff. Krohn is cited by Hylan in the latter's article on "The Distribution of Attention", *Psych. Rev.*, 1903, x. Quandt, *Psychol. Stud.* i, 1906. For further investigation of the "span", see Dietze, *Phil. Stud.* ii, 1885, p. 362 ff.

§ 3, p. 90. Aristotle, *De Anima*, B, § 5. Buridan: see Siebeck's *Beiträge z. Entstehungsgeschichte d. neueren Psychologie*, 1891. Malebranche, *Recherche de la vérité*, Bk. VI, Pt. I, ch. v.

§ 4, p. 91. Fichte, *Psychologie*, 1864, Pt. I, p. 67; Pt. II, p. 7; Lehmann, *Körp. Aeusser. psych. Zustände*, i, 1901, p. 199; ii, 1905, p. 362.

p. 95. A very recent and important discussion of the hypothesis of mental energy has come from McDougall, "Dynamics of the Gestalt Psychology", in *Character and Personality*, 1936.

p. 97. Lashley, *Brain Mechanisms and Intelligence*, 1929, p. 25.

§ 5, p. 98. Herbart in his *Lelub. z. Psychol.*, 1816, p. 104, writes: "*Der Hauptgrundsatz zur Bestimmung der Hemmungs-Summe est, dass man sie als möglichst klein betrachten musse, weil alle Vorstellungen der Hemmung entgegenstreben, und gewiss nicht mehr als nötig davon übernehmen*". For Sherrington and Wundt, see respectively, *Integrative Action of the Nervous System*, 1906, p. 234, and *Grundz. d. Phys. Psychol.*, 1908, vol. i, ch. vi, p. 379.

CHAPTER XXXIII

§ 1, p. 103. Mosso, *Fatigue*, 1902, p. 317. Marx, *Capital*, 1892, p. 161.

§ 2, p. 106. For Kraepelin, see especially his *Psychol. Arbeiten*, from 1899. For a general account of the work of this school, see Wundt, *Grundz. d. phys. Psychol.* pp. 587 ff. Arai, *Mental Fatigue*, 1912; Ritchie, *Forum of Education*, 1924.

p. 107. For Chapman and Phillips' work, see respectively *Journ. Ed. Psychol.* vi, 1915, and *Mental Fatigue*, Records of the Education Soc. Teachers' Coll., Sydney, no. 40, 1920.

§ 3, p. 109. It may be remarked that a certain amount of fatigue is not necessarily undesirable. It seems rather to be the normal and healthy state.

§ 4, p. 110. Wyatt, Reports of Industrial Fatigue Research Board, no. 23, p. 37, and no. 26, p. 30. The passage describing fatigue is taken from Thorndike in *Journal Ed. Psychol.* ii, 1911.

§ 6, p. 112. Bain, *The Senses and the Intellect*, 3rd ed., 1838, pp. 8, 321. Hobbes: *Sentire semper idem, et non sentire, ad idem recidunt* (*Elem. Philos.* Pt. IV, ch. 25, para. 5).

§ 8, p. 114. Flugel, "Practice Fatigue, and Oscillation", *Brit. J. Psychol. Mon. Suppl.*, 1928; Philpott, "Fluctuations in Human Output", *Brit. J. Psych.*, 1932; Chen, *ibid.*, 1935; Walton, *ibid.*, 1936; Entwistle, *ibid.*, 1937.

CHAPTER XXXIV

§ 2, p. 120. For the four references to Aristotle, see his *De Anima*, Bk. II, ch. v, 417 a; ch. xii, 424 a; ch. v, 418 a; and Bk. III, ch. iv, 429 a.

§ 3, p. 121. In the language of Locke, be it remembered, the term "idea" included all items of cognition, including sensation itself. The two quotations are taken from his *Hum. Underst.* Bk. II, ch. ii, §§ 2-3.

§ 4, p. 122. The "reflection" of Locke seems to be generally misinterpreted. It is taken in its ordinary meaning, which comprises such operations as analysing, compounding, abstracting, and generalizing; see Fleming's *Vocabulary of Philosophy.* But Locke, as the quotation shows, did *not* mean these operations; he meant the superposed perceiving of one of our operations. The matter is complicated by the fact that the expression "internal sense" is itself highly equivocal. It now commonly and naturally denotes direct awareness of experience. But originally it was used as a translation of the scholastic *sensus communis*, which comprised such things as imagination and memory.

p. 125. For the emergence of knowledge by way of clarification, see Chapters XII and XV. For a slightly more rigorous formulation of the Law of Experience, see *The Nature of Intelligence*, p. 342.

§ 5, p. 125. The quotation from Locke on relations comes from his *Human Underst.* Bk. II, ch. xi.

p. 127. Wynn Jones, *Theory and Practice of Psychology*, 1934, pp. 79 ff. For a more detailed account of the law of relations, see the writer's *Nature of Intelligence*, 1922, chs. v and vi.

§ 6, p. 128. For the Epicurean and the Stoic doctrines, see Diogenes Laertius. Hume, *Treatise*, Bk. I, Pt. I, § 1; Hartley, *Observations*, ch. iii, § 5, p. 257.

p. 131. Line: see especially his "Growth of Visual Perception in Children", *Brit. J. Psych. Mon. Suppl.*, 1931, lxviii; "Lehre d. Noegenesis", *Arch. f. d. ges. Psychol.*, 1929. Mercer, Thesis, *Influence of Volition upon Perception*, Library Univ. London, 1933.

§ 7, p. 132. The figure illustrating knowledge of relations is taken from *Brit. J. Psychol.* xv, 1922, p. 222. There has been considerable question as to whether the action of the first and of the second laws are distinct operations. The reply must

needs be in the affirmative, because undeniably the second law *occasionally* does act subsequently to the other one; nothing is commoner than to perceive a relation long after perceiving the items related. This much is all that is needed to prove the point. But it is possible to go still further and maintain that the action of the second law is not only occasionally but *always* posterior; that it has at least a "logical" posteriority. By this is meant a relation like that of effect to cause; this effect is always said to "follow", although it is not separated from the cause by any interval, even the smallest.

§ 8, p. 136. For an interesting experimental comparison of eduction with reproduction, see Strasheim, *New Method of Mental Testing*, 1926.

§ 10, p. 139. "As perfect as the prevailing conditions admit": *Psychologies of 1925*, p. 142. "Closure": see Petermann's *The Gestalt Theory*, 1932, p. 276.

CHAPTER XXXV

§ 1, p. 144. Hartley, *Observations of Man*, § 3, Prop. lxxxix.

§ 2, p. 146. Paulhan, *Les Caractères*, 1894, Preface. Ribot, *La Logique des sentiments*, 4th ed., 1912, pp. 2-3; Shand, *The Foundations of Character*, 1914, p. 21; McDougall, *Social Psychology*, 1908, ch. v.

§ 3, p. 147. Shand, *op. cit.* pp. 38, 62.

§ 4, p. 149. The case of Jung is reported by Freud in his *Psycho-Pathology of Everyday Life*, 1914, p. 43. Moore, *Dynamic Psychology*, 1924, p. 225.

§ 5, p. 151. The three passages of Aveling are from *Brit. J. Psychol.*, 1926, xvi.

p. 152. Bonnet, *Essai analytique sur les facultés des âmes*, 1760, § 131.

§ 6, p. 153. Shand, *op. cit.* Bk. I, ch. viii, especially pp. 84, 90.

CHAPTER XXXVI

§ 3, p. 159. For Weber's law, see Wagner's *Handw. d. Physiol.*, 1851, vol. iii, Pt. II, pp. 559 ff. For that of Müller, see his *Handbuch d. Physiol.*, 1833–40.

§ 4, p. 160. Berman, *The Glands regulating Personality*, 2nd ed., 1928, pp. 49, 53, 67, 204.

§ 5, p. 161. For Spalding's experiment, see *Macmillan's Magazine*, xxvii, 1873.

p. 162. Miss Shinn is quoted from her *Development of a Child*, ii, 1893–1909, pp. 144-5.

p. 163. "Maturation": see Ch. Bühler, *Kindheit u. Jugend*, 1931, especially pp. 56, 175.

§ 6, p. 164. Plato, *Republic*, 481.

p. 165. For the tricks said to be inherited by rats, see the remarkable but disputed experiments of McDougall, *Brit. J. Psychol.*, 1927, xvii, p. 267, and 1930, xx, p. 201.

§ 9, p. 167. For Hazlitt and Thomas, see respectively their *Ability*, 1926, and *Ability and Knowledge*, 1935.

CHAPTER XXXVII

§ 1, p. 174. Bacon, *Advancement of Learning*, 1606, Bk. VII, ch. iii.

§ 4, p. 176. Aquinas, *Summ. Theol.* Pt. I, Q. lxxxv.

p. 177. Gall and Spurzheim, *Anatomie et physiologie du système nerveux*, 1810 ff.

§ 7, p. 178. Bain, *The Study of Character*, 1861 ; Fouillée, *Tempérament et caractère selon les individus, les sexes, et les races*, 1895 ; Malapert, *Les Éléments du caractère*, 1906.

p. 179. Jordan, *Character as Seen in Body and Parentage*, 1890 ; Ribot, " Les Diverses Formes du caractère ", *Revue Philos.*, 1892 ; Heymans and Wiersma, " Beiträge zur spezieller Psychologie", *Zt. f. ang. Psychol.*, 1906–9 ; Queyrat, *Les Caractères*, 1911 ; Fourier, *Passions of the Human Soul*, 1851 ; Ernest Jones, *Papers on Psycho-analysis*, 1919.

§ 8, pp. 180-81. For the older doctrines of temperament reference may be made to Siebeck's *Geschichte der Psychologie*.

p. 182. Burton is quoted from his *Anatomy of Melancholy*, 1621, Pt. I, Sec. I, memb. ii, subs. 2. The following are the references for the subsequent contributions to the doctrine of temperaments. In compiling this list, occasional use has been made of the laborious *Bibliography* of Roback. Rüdiger, *Physica Divina*, 1716 ; Stahl, *Neuverbesserte Lehre von Temperamenten*, 1723 ; Haller, *Elemente Physiologicae*, 1757 ; Wrisberg ; Henle, *Anthropol. Vorträge*, 1876 ; Pilo, *Nuovi Studi sul carattere*, 1893 ; Fouillée, *Tempérament et caractère*, 1895 ; Seeland, Congrès Intern. d'Archéll. et d'Anthropol., 1892 ; Platner, *Philos. Aphorismen*, 1776–82 ; Bahnsen, *Beiträge z. Charakterologie*, 1867 ; Kant, *Anthropologie*, 1800, Bk. II, Pt. 2 ; Wundt, *Grundz. d. phys. Psychol.*, 1911, pp. 612 ff. ; Meumann, *Intelligenz u. Wille*, 1907 ; Elsenhans, *Charakterbildung*, 1908 ; Jastrow, *Character and Temperament*, 1915 ; Ach, *Ueber d. Willensakt u. d. Temperament*, 1910.

§ 9, p. 184. Wundt, *Grundz. d. physiol. Psychologie*, 1911, p. 613 ; Beneke, *Lehrb. d. Psychologie*, 1845 ; *Pragmatische Psychologie*, 1850 ; Perez, " Le Caractère et les mouvements ", *Rev. philos.*, 1891, vol. xxxi ; Müller and Pilzecker, *Gedächtnis*, 1900, ch. iii ; Gross, *Die cerebrale Sekundärfunktion*, 1902.

p. 185. McDougall, *J. Abn. and Soc. Psychology*, 1929.

§ 10, p. 186. Klemm, *Geschichte der Psychologie*, 1911, p. 216.

CHAPTER XXXVIII

§ 1, p. 189. For the contributions of Laugier, see the Bulletin, *Biotypologie*, Paris.

p. 190. Stern, *Die differentielle Psychologie*, 1911 ; *Die menschliche Persönlichkeit*, 1918—also his numerous publications on *Testimony* (*Die Aussage*) ; Geyser, *Lehrbuch d. allg. Psychologie*, 1908 ; Klüver, *Am. J. Psychiatry*, 1931 ; Helwig, *Charakterologie*, 1936.

§ 2, p. 192. Dilthey, *Beiträge z. Studium d. Individualität*, 1896 ; Spranger, *Lebensformen*, 3rd ed., 1922 ; Klages, *Science of Character*, 1929.

§ 3, p. 194. Binet, see *l'Année Psychologique* ; Stern, *Die Intelligenz der Kinder*, 1922 ; Baerwald, *Zur Psychologie der Vorstellungstypen*, 1916 ; Kurella, *Die Intellektuellen u. die Gesellschaft*, 1913 ; Partridge, *Outline of Individual Study*, 1910.

§ 5, p. 196. Jung, *Psychological Types*, trans. Baynes, 1923, and *Eidetic Imagery*, 1930.

§ 6, p. 197. Kretschmer, *Physique and Character*, 1925.

§ 7, p. 199. Jaensch, *Deut. Zeit. f. Nervenheilkunde*, 1925 ; Ach, *Analyse des Willens*, 1935.

§ 9, p. 203. Mall, *Körperl. Begleiterschein. affektiver Zustände*, 1936 ; Bayer, *Assoziation u. Perseveration*, 1929.

§ 10, p. 205. For a fuller account of German typology, reference may be made to the present author, " German Science of Character " in the quarterly *Character and Personality*, 1937.

CHAPTER XXXIX

§ 1, pp. 206-9. The lines urging the need of correlational coefficients come from the present writer, *Am. Journ. Psychol.* xv, 1904. Besides Galton, the great leaders in the development of correlational coefficients have been Bravais, Pearson, and Udny Yule. Notable among the text-books about them with special reference to psychology have been : *Statistical Method* by Kelley, 1923, and *Statistical Methods for Students in Education* by Holzinger, 1928.

§ 2, p. 210. Stern wrote in *Character and Personality*, 1925. As notable among other authors who have regarded correlational coefficients in a rather critical spirit may be mentioned : Vernon, see his articles in *Brit. J. Psychol.* xxiv, 1933, and in *Character and Personality*, 1935. See also the following : Chant, *J. Ed. Psychol.*, 1935 ; Helke, *Zeit. f. allg. Psychologie*, 1935 ; Lewin, *Dynamic Theory of Personality*, 1935. For the opposite side of the question, see Spearman, *Character and Personality*, 1935 and 1937.

CHAPTER XL

§ 2, pp. 218-20. The finally preferred criterion of " hierarchy " was as follows : Take the ratio between any two values from the

same column; for instance, $\cdot 6/\cdot 3$ from column a. And then take the ratio between the corresponding two values in any other column (in this case there is only one such further ratio, namely, $\cdot 4/\cdot 2$ in column b). The "hierarchy" means that the two ratios are always equal. In the present table this is obviously true. For we get $\cdot 6/\cdot 3 = \cdot 4/\cdot 2$. Generally this equation is pushed a little further, yielding:

$$\cdot 6 \times \cdot 2 - \cdot 4 \times \cdot 3 = 0 \quad . \quad . \quad . \quad (\mathrm{I})$$

Expressed more generally, we have throughout the whole table of correlations:

$$r_{ab}\, r_{cd} - r_{ac}\, r_{bd} = 0 \quad . \quad . \quad . \quad (\mathrm{II})$$

where a, b, c, and d stand for the tests in every possible set of four. The value on the left of (I) or (II) is usually called a "tetrad-difference", or more simply a "tetrad". For the mathematical proof of this formula (II), see Spearman, *Abilities of Man*, Appendix, p. iii.

§ 3, pp. 220-22. The best estimate of the "G" of any individual is given by $G = (1+S)^{-1}\Sigma\{ur_{ug}/(1-r^2_{ug})\}$, where u stands for any single test score, whilst S is an abbreviation for $S\{r^2_{ug}/(1-r^2_{ug})\}$, whilst the number of tests, or their saturation, or both, are assumed to be large. See Spearman, *J. Ed. Psychol.*, 1934, p. 142; Irwin, *B. J. Psych.* xxv, 1935, p. 394; Piaggio, *ibidem*, p. 485.

§ 4, pp. 222-4. The question as to the uniqueness of "G" was first raised in a profound article of E. B. Wilson, *Science*, lxvii, 1928, p. 247. It was answered by Irwin, *B. J. Psychol.* xxii, 1932. It was treated by Spearman, *J. Ed. Psychol.*, 1934, p. 142. Further illumination came from Piaggio, *B. J. Psych.* xxv, 1935. Thouless, *Nat. Instit. Ind. Psych. J.*, 1935.

§ 5, pp. 224-7. Nine preliminary reports of this experiment have been issued by Holzinger with the assistance of Swineford. The general and complete report from him and Spearman may be expected shortly. The helpers in this strenuous work were too numerous to be mentioned separately. Outstanding, however, from beginning to end was the figure of Reymert in his capacity as Director of the Mooseheart Laboratory for Child Research, see *Am. J. Psych.*, 1931.

§ 6, p. 227. The early evidence for the universality of "G" was given by Spearman, *Abilities of Man*, 1926, ch. xi.

§ 7, pp. 227-33. Billings, *Am. J. Psychol.* xlvi, 1934; Hargreaves, *B. J. Psych. Mon. Suppl.*, 1927; McQueen, *B. J. Psych. Mon. Suppl.*, 1917; Strasheim, *Educ. Psychol. Mon.*, 1926. For the unexpectedly small influence of intense effort, see particularly the research of C. C. Howard, Thesis, London University, 1932. For the influence of the basal conditions, see Spearman, *Abilities of Man*, 1927, chs. xxi-xxii.

§ 8, pp. 233-7. For Cattell's fuller account of the relation between "G" and "intelligence", see his *Your Mind and Mine*, 1934, ch. ii. The references for "attention" are as follows: Burt,

B. J. P. iii, 1909; Woodrow, *J. Exp. Psych.* i, 1916; Maxwell Garnett, *B. J. P.* ix, 1919. McDougall's hypothesis of "energy" is given by him in *Character and Personality*, 1934. The chief direct evidence against this "concentration" view has been derived from the experimental results of Koch and Habrich: see *Abilities of Man*, p. 343. Philpott, *B. J. Psych.* xxvii, 1936. For the doctrine of "chance", see Spearman, *B. J. Educ. Psych.* i, 1931, and Thomson, *B. J. Psych.* xxvi, 1935. For Kelley on "maturity", see his *Crossroads in the Mind of Man*, 1928. See also McManara, Dissertation, Catholic University, America, 1936. For "heterogeneity", see Cureton and Dunlap, *Am. J. Psych.* xlii, 1930; also Spearman, *ibidem*. Garrett, Bryan, and Perl, *Archives of Psych.* 196.

§ 9, pp. 237-40. Wynn Jones, *Theory and Practice of Psychology*, 1930, ch. viii; J. B. Wilson: see above in note to § 4. The work of Brown and Stephenson, perhaps the most important of all the later contributions to the theory, was published in the *B. J. Psych.* xxiii, 1933. Thomas, *Ability and Knowledge*, 1935; Brigham, *A Study of Error*, 1932, p. 23; Banks, *Conduct and Ability*, 1936. For a general treatment of the controversy by the present writer—including the references to Garrett, Hull, Myers, Otis, Thomson, Kelley, and Thorndike—see "The Factor Theory and its Troubles", *J. Educ. Psych.*, 1933–4. For subsequent general accounts by other authors, see the quoted works of Wynn Jones, Thomas, and Banks. A large proportion of the purely statistical contributions have appeared in the said *J. Educ. Psych.* Interesting is the little work of Jorgensen on *Analysis by the Spearman Factor Method*, 1932; see also R. Knight, *Intelligence*, 1933. Also Gaw and Earle, 1925 and 1929, Reports of Industrial Fatigue Research Board. An outstanding recent contribution to the topic has been that of Alexander, *B. J. Psych. Mon. Suppl.* xix, 1935. Jha, *Modern Educational Psychology*, 1933.

CHAPTER XLI

pp. 242-4. Just as there is a formula for measuring the "G" of any individual (see preceding chapter), so also there is one to measure any of his "S's". But all such measures of how much of any factor is possessed by any individual must be carefully distinguished from the quite different measures of how much of any factor is called for in any ability. It runs as follows:

$$S_a = (1 - r^2_{ag})^{-\frac{1}{2}}(A - G.r_{ag}),$$

where A is the score of the individual for any total ability, r_{ag} is the correlation between this total ability and the general

factor G, whilst S is the required specific factor. See Piaggio, *Brit. J. Psych.* xxv, 1935, p. 488.

§ 3, pp. 245-7. These "group factors" have caused far more misunderstandings than anything else. See Spearman, *J. Educ. Psych.*, 1933, pp. 591-601.

§ 4, pp. 247-51. This depreciation of the "narrow" factors must not be pushed too far. Sometimes what seems introspectively a "narrow" factor has nevertheless wide-reaching results. An instance is the power of perceiving musical relations, studied with such extraordinary success by Seashore. The work of Davey was published in *B. J. Psych.*, 1926; that of Stephenson in *J. Educ. Psych.*, 1931. There seems to have been some misinterpretation of the fact that the latter author attached more importance to the verbal factor than the former author did. Actually, both researches were done under the supervision of Spearman and both authors were in complete agreement with him. The change of opinion was not due to the change of investigator, but only to the additional investigation, which brought further evidence.

The other quotations are: Kelley, *Crossroads in the Mind of Man*, 1928; Alexander, *B. J. Psychol. Mon. Suppl.* xix, 1935; Clarke, Thesis, London Univ., 1936; Riley, Dissertation, Catholic Univ., America, 1929.

§ 5, pp. 251-6. The references for the conjunctive as arithmetical factor are: Brown, *Biometrika*, vii, 1916; Rogers, Columbia Univ. Contr. Educ., Teachers' College Series, No. 130, 1923; Collar, *B. J. Psych.* xi, 1920. For Cox, see his *Mechanical Aptitude*, 1928; also his *Manual Skill*, 1934. For Alexander, see his work mentioned above. For Pintner, see his *Scale of Performance Tests*, 1917. For Russell, see *B. J. Psych.*, 1934. An interesting research by El Koussey claimed to detect a factor of "visual spatial imagery", *B. J. Psych. Mon. Suppl.*, 1935.

§ 6, pp. 256-8. For the reference to Spearman on retentivity, see his work with Krueger, *Zeit. f. Psychol.*, 1906. Carey, *B. J. Psych.* xvii, 1926; Kelley, *Crossroads*, etc., mentioned above; Weinberg, *Biotypologie et aptitudes scolaires*, 1933; Anastasi, *Archives psychol.*, No. 120, 1930; No. 142, 1932.

§ 7, p. 258. For Bernstein on Speed, see *B. J. Psych. Mon. Suppl.* vii, 1924. For Hargreaves, see *B. J. Psych. Mon. Suppl.*, 1926. A later work of importance is the London Thesis of Howard. See also Studman, *Brit. J. Med. Psychol.*, 1934.

§ 8, pp. 259-60. For references about "F", "O", and "P", see next chapter.

CHAPTER XLII

§ 2, pp. 263-6. Webb, *B. J. Psych. Mon. Suppl.* iii, 1915; Burt, 3-page abstract in *Proc. Brit. Ass. Adv. Science*, 1915; Garnett, *B. J. Psych.* ix, 1919. The original work of Hartshorne,

May, and Maller appeared as *Studies in the Nature of Character*, II. *Studies in Service and Self-control*, 1929. Maller's emendation appeared in *Journ. Social Psychology*, v, 1934, pp. 97-102.

§ 3, pp. 266-70. The first systematic application of adequate statistical method to the investigation of "P" was that of Lankes, *B. J. Psych.* vii, 1914. The work of Pinard on *Perseveration and Difficult Children* appeared as a Thesis at the University of London, 1929. The reference for Howard is the same as before. For the researches of Cattell, see *B. J. Psych.* xxiii, xxiv, 1933. For Clarke, see her Thesis as above. Notable work on the subject has been done by Wynn Jones, *Theory and Practice of Psychology*, 1934, ch. xviii.

§ 4, pp. 270-71. For Hargreaves the reference is as given above; for Cattell, similarly. For Studman, see *B. J. Med. Psych.* xxv, 1934; *J. Mental Science*, 1935. Pachauri, *B. J. Psych.* xxv, 1935; xxvii, 1936; Wynn Jones, as before.

§ 5, p. 272. The outstanding work on oscillation is due to Flugel, *B. J. Psych. Mon. Suppl.*, 1928. See also his *Hundred Years of Psychology*, 1933. Other references are the following: Philpott, *Brit. J. Psych. Mon. Suppl.*, 1932; Wynn Jones, *Theory and Practice of Psychology*, 1934, ch. xix; Bernstein, *Brit. J. Psych. Mon. Suppl.*, 1924. The psychopathic significance of "O" has been chiefly investigated by Stephenson, Simmins, and Studman, *B. J. Med. Psych.*, 1934, also by Walton, *B. J. Psych.*, 1936. Moore's research was published in June 1933 in *Studies in Psychology and Psychiatry*, vol. iii, No. 3.

§ 7, p. 277. The words of Line, Griffin, and Anderson appear in their study cited below. Jasper, *Psychologie d. Weltanschauungen*, 3rd ed., 1925.

§ 8, pp. 278-80. Garnett, *B. J. Psych.* x, 245; *Proc. Roy. Soc.*, A, xcvi, 91; *B. J. Psych.* xxv, 1934; Kelley, *Crossroads*, etc., 1927; *Essential Traits of Mental Life*, 1935, pp. 61-2; Thurstone, *Vectors of Mind*, pp. 48-54, 129-31; Hotelling, *J. Educ. Psych.*, 1933, pp. 417 and 498. A very lucid account of Thurstone's method has been given by Margineanu, *Année psychol.*, 1934. The work of Line, Griffin, and Anderson appeared in the *Journal Mental Science*, 1935, and contains the most penetrating criticism of the "Vector" method in its practical application. See also Line's earlier study of factorial analysis in *B. J. Psych.* xxiv, 1933. Holzinger and Swineford, *Psychometrika*, 1937. Further contributions, on lines akin to the "inverted factor technique" of Stephenson, have just been supplied by Burt, *B. J. Psych.* xxviii, 1937.

p. 280. For a popular account of "talents and temperaments", see the book of that name by McCrae, 1932. For Landis, Zubin, and S. Katz, see *J. Ed. Psych.*, 1935. For Anastasi, see *Genetic*

Psych. Mon., 1936. For the basal concordance of the different methods, see especially the following works: Thomson, *J. Ed. Psych.* xxv, 1934; Alexander, *B. J. Psych. Mon. Suppl.*, 1935; Kelley, *Essential Traits of Mental Life*, 1935; Kellogg, *J. Ed. Psych.* xxvii, 1936; Clarke, Thesis, University of London, 1936. Two other interesting applications of the new methods have been made by Flanagan, *Factor Analysis*, 1934, and by Perry, *Group Factor Analysis*, 1934. The former is especially interested in the methods of Hotelling and the problem of abilities, but finds that this approach, like that of " tetrads ", indicates a " large common factor " (p. 76). Perry is more concerned with the procedure of Thurstone and the problem of character traits, but he also arrives at good agreement with the tetrads (p. 78).

We may conclude this chapter by noting the important event that all this investigation of factors is now being vigorously taken up in France by such men as Darmois (see *Biotypologie*, vol. iii, 1935).

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